Science Series 27
June 30, 1974

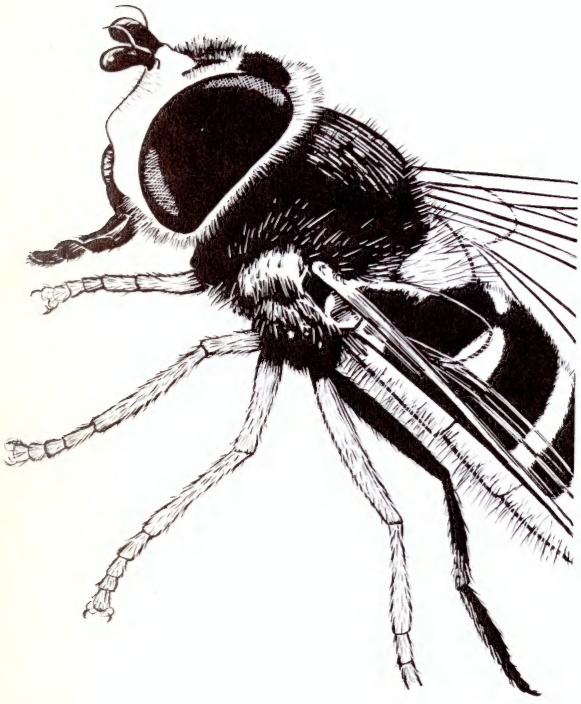
THE INSECTS *of the Los Angeles Basin*

By Charles L. Hogue

NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY

COVER PHOTO: Syrphid fly portrait, by Charles L. Hogue

THE INSECTS OF THE LOS ANGELES BASIN



THE INSECTS
of the Los Angeles Basin

By Charles L. Hogue

NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY

Science Series 27
June 30, 1974

SERIAL PUBLICATIONS OF THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY

Prior to November 30, 1973, publications of the Natural History Museum have appeared under various formats—*Leaflet Series, Museum Graphic, Science Series, Study Guides, Contributions in Science, Contributions in History, Science Bulletins,* unnumbered catalogs of exhibitions, and other miscellaneous publications. The Museum now publishes the following serials at irregular intervals as CONTRIBUTIONS IN SCIENCE, HISTORY BULLETINS, SCIENCE BULLETINS, EDUCATION SERIES, HISTORY SERIES, and SCIENCE SERIES. The Contributions are short papers of octavo size. The Bulletins are longer, comprehensive papers of quarto size. The Series are papers of variable lengths of quarto or larger size. Papers in each serial are numbered separately and consecutively.

SCIENCE SERIES contain original articles in a popular style in the earth and life sciences, presently newly acquired information or re-interpretation. They are intended for the publication of research of broad scope and general nature. Number 1 was issued on April 15, 1930; it and all subsequent issues to number 25 were numbered separately according to science discipline.

Robert J. Lavenberg, EDITOR, SCIENCE SERIES
Natural History Museum of
Los Angeles County

Correct citation:
Natural History Museum of Los Angeles County, Science Series 27:1-174

Price: $6.00

All communications concerning manuscripts and exchange of or purchase of publications should be sent to the Editor, Museum Publications, Natural History Museum of Los Angeles, 900 Exposition Boulevard, Los Angeles, California 90007

Printed in the United States of America
by Continental Graphics, Los Angeles, California

TABLE OF CONTENTS

PREFACE ..... *vii*

ACKNOWLEDGMENTS ..... *ix*

INTRODUCTION 1

Structure and Function of the Insect Body 1

Insect Growth and Development 5

Keeping Insects in Captivity 9

Making an Insect Collection 10

Finding Out More About Insects 12

Insect Classification and the Orders of Insects 15

INSECTS OF THE LOS ANGELES BASIN 18

The Environment 18

Common and Conspicuous Insects 22

Common Terrestrial Arthropods 142

Prehistoric Insects 162

Insect Pests in the Basin 163

INDEX 165

This work is affectionately dedicated

to my sister

LEONORA McTERNAN

for introducing me

to the fascinating world of insects

Preface

THIS BOOKLET is for the Angeleno. Its purpose is to give the lay urban and suburban dweller of the Greater Los Angeles Basin a means of identifying and understanding the insects and related terrestrial arthropods that most likely might be encountered. The area treated is shown on the map (Fig. 1) and includes not only the Basin in the narrow sense, i.e., the floor of the coastal plain (with its hill systems) south of the foot of the San Gabriel Mountains to the sea, but also the Santa Monica Mountains and San Fernando and San Gabriel Valleys.

One might suppose that the need for such a guide would be negligible today, there being few insects surviving in such a heavily developed area as Los Angeles and its neighboring cities. But our fauna of these invertebrate animals is extensive. Not only are there still many almost natural areas which support communities of innumerable species, but remnants of the assemblages of our native insects find haven in semi-improved portions, in the gardens and vacant lots of the suburbs, in parks, and many other refuges, even in the midst of civic complexes. And there is a considerable number of forms which, like the Starling and Opossum, have adapted completely to civilization and even share our homes and buildings. Furthermore, although the geographic area is relatively small, the human population is immense. Where two major groups of organisms are in contact, insects and 7 million people, there seems an obvious need for an investigation and record of their interactions and mutual tolerance.

It would be very difficult, if not impossible, to cite accurately the total number of insects and their close relatives that live in the Basin; the figure probably would lie somewhere between 3 and 4 thousand. This guide contains reference to some 350. Most are illustrated with photographs of living specimens. In the text I have attempted to answer only the commonest questions about each type, questions such as I receive almost daily in my position as Senior Curator of Entomology at the Natural History Museum in Los Angeles and that I have asked and answered as a student of local insect life since the age of nine. In some cases it satisfies the inquirer simply to know the name of "the bug." More commonly, the layman is interested only in the salient facts of a species' habitat or ecology: Does it sting? What does it eat? Where does it live? and so on. The questions are as different as the variety of species and questioners.

It may come as a surprise to many readers that little is known of the habits of a considerable number of our local insects. There is a definite need for research to determine basic facts on immature stages, seasonal cycles, food preferences, etc. of perhaps the majority of species. Hopefully this modest introduction to our insect fauna may stimulate entomologists, amateur and professional alike, to study even our commonest forms.

I do not provide recommendations for insecticidal eradication of pest species. There are many handbooks of pest control for this purpose. The economically important forms are discussed, however, and the reader will be able to identify and know his insect adversaries and thus plan an intelligent course of action against them. Wherever available I give pertinent published references where more information may be had, and have tried to list all public offices and other sources of assistance in entomological matters.

C. L. H.

28 December 1973

Acknowledgments

NUMEROUS entomologists contributed to the content and presentation of this manual: Charles P. Alexander, Phillip A. Adams, Richard K. Allen, John N. Belkin, Leland R. Brown, George M. Buxton, Willis J. Gertsch, George L. Godfrey, Carll Goodpasture, Harold J. Grant, Jr. (deceased), Bernard Greenberg, Lorin R. Gillogly, Clifford Hoffman, James R. Honey, Noel Kobayashi, Donald C. Lowrie, Richard J. McCrea, Marjorie J. Moody, Martin H. Muma, Dennis R. Paulson, Frank W. Pelsue, Roy J. Pence, James A. Robertson, Donold L. Rohe, Findlay E. Russell, Robert X. Schick, John D. Spooner, Lionel A. Stange, Mel E. Thomsen, Darwin L. Tiemann, William G. Waldron, and Stanley C. Williams.

Credits for the numerous photographs and illustrations used in this volume are as follows: Leland R. Brown (20, 23, 37, 52, 54, 65, 66b, 68, 70, 71, 72b, 84c, 87e, 87g right, 88b, 89b, 90b, 95b, 96b, 98b, 103b-c, 108b, 110, 113, 115b, 129b-c, 136a, 139b, 147, 200, 215, 218b, 220c-d); Elmer P. Catts, Jr. (160); Commander Charles M. Dammers (124b-c, 127b-c, 130c, 131b-c, 133c-d, 136b-c); Ruth Ann DeNicola (203-205); Julian P. Donahue (81a, 97b, 102, 173, 195, Plate II-12); George L. Godfrey (87a right, 87f right); Carll Goodpasture (8b, 18, 19b, 118, 129a, 138, 142c-d, 149); Clifford Hoffman (232); Charles L. Hogue (19a, 22, 25, 27, 36, 43a, 47, 49, 50a, 53, 60, 61, 62, 67, 74, 75, 77, 79, 80, 84a, 87a, 87b left, 87e, 87h left, 88a, 89a, 90a, 91a, 93, 99b, 104, 105a, 125b, 128, 140, 141a, 145-146, 148, 152-153, 155, 158-159, 166-167a, 168, 174, 176-177, 181a, 184, 186, 188, 190, 193-194, 197-206, 209, 211, 216-217, 219-220b, 221, 224, 227, 229b-c, 234, 248, 250, Plate I-1 to 8, Plate II-9, 11 to 15); James R. Honey (28, 64, 124a, 141b, 142a-b, 143, 163); G. Jenks (230); J. Donald Lafontaine (87c, 87d right); Caryl Maloof (1); Lee Passmore (Courtesy San Diego Museum of Natural History) (38, 39, 59, 83b-c, 114, 229a, 249); Dennis R. Paulsen (13, 14, 15a); Roy J. Pence (7, 16, 29, 30, 31, 35a, 41, 42, 43b-c, 44, 51, 56, 58, 69, 73, 76, 84b, 94, 103a, 106, 115a, 117b, 144, 154, 161-162, 165, 167b, 179, 183, 189, 196, 207-208, 213, 218a, 220a, 222, 231, 236-237, 247, 251-252); Lawrence S. Reynolds (10, 11, 33, 57, 83a, 86, 87c, 87d left, 92, 96a, 98a, 101, 108a, 109, 111, 117a, 120-121, 125a, 126a, 127a, 130a-b, 131a, 132, 133a-b, 135, 137, 139a, 150, 170-171); Darwin L. Tiemann (81b, 97a, 99a, 122, 130d); Stanley Williams (223, 225).

Special acknowledgment is due my colleagues in entomology at the Museum—Julian P. Donahue, Lloyd M. Martin (retired), Roy R. Snelling, and Fred S. Truxal—for generously giving so much to this project. Their donations of information, and their time and talents in suggesting better ways to present facts and in reviewing the text, are greatly appreciated.

Also, I would like to thank Terri Kato, Sherry Owings and Dorothy Fink for typing the final manuscript and especially Mrs. William Birdsall for converting my original, handwritten draft to typescript, in the process offering countless suggestions toward the improvement of its clarity. The map was drawn by Caryl Maloof, and Lawrence Reynolds prepared the large number of excellent photoprints from varying and sometimes poor originals; their help is also appreciated.

Finally, I gratefully acknowledge the support of the County of Los Angeles and the Natural History Museum in approving and financing this publication.

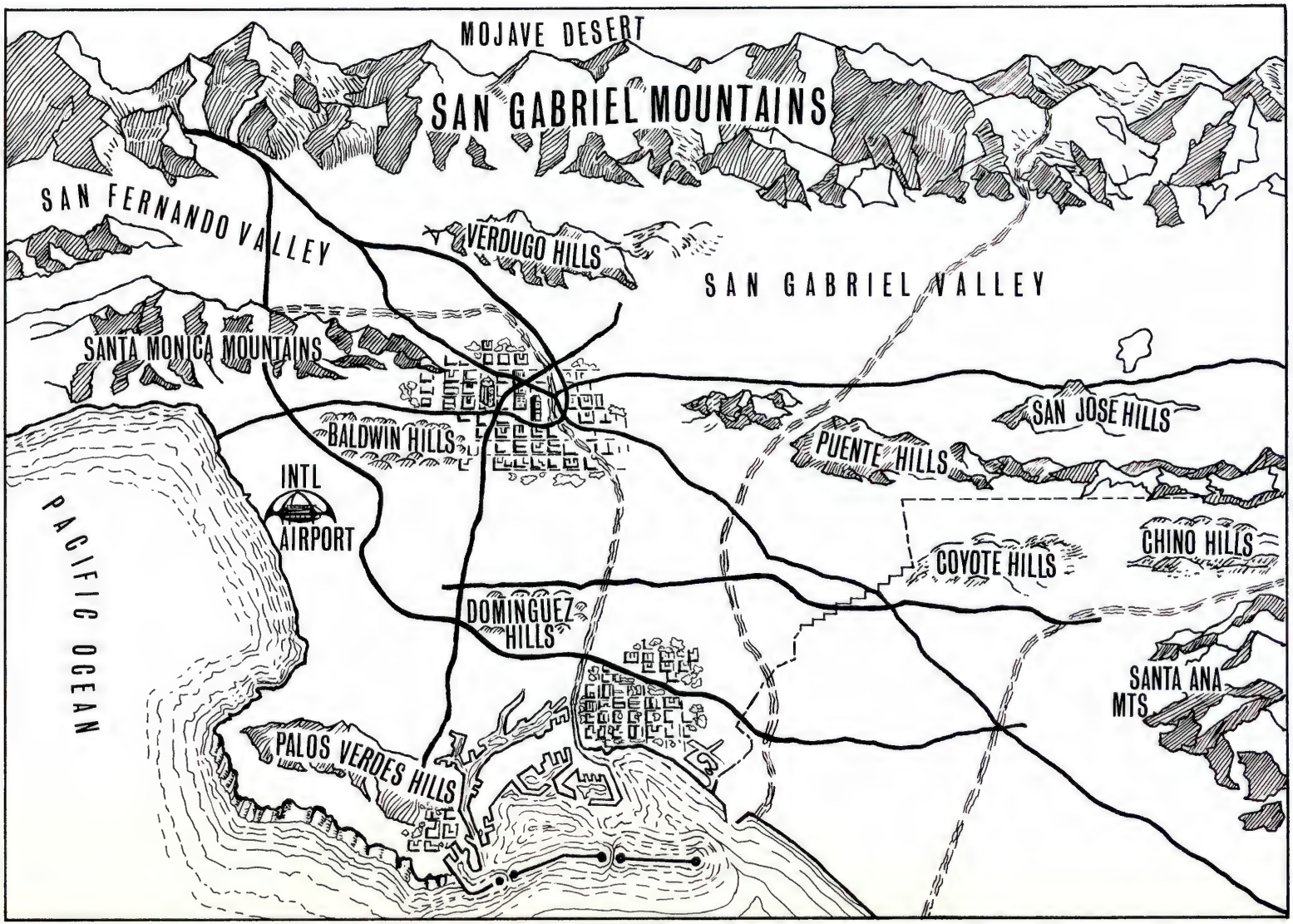


Figure 1. Major topographic features of the Los Angeles Basin, California.

THE INSECTS OF THE LOS ANGELES BASIN

A Pictorial Guide to the Common and Conspicuous Insects and Related Terrestrial Arthropods of the Greater Los Angeles Area

By Charles L. Hogue[1]

INTRODUCTION

STRUCTURE AND FUNCTION OF THE INSECT BODY

Insects belong to the phylum Arthropoda and therefore exhibit as their most outstanding characteristics a segmented body with jointed appendanges, and a hardened outer shell or "exoskeleton." The segments of the body are not all alike but are fused into three functional regions: the *head, thorax* and *abdomen* (Fig. 3). Each region serves its own set of functions.

The head is the chief orientation center, bearing the eyes and supplementary sensory organs, the antennae. The mouth is surrounded by several structures collectively known as the mouthparts: the mandibles (or jaws); labrum (upper lip); labium (lower lip); maxillae (accessory jaws) and hypopharynx (tongue). As they are arranged in chewing insects, these elements are illustrated in Figure 2.

Many insects take liquid food and accordingly possess a set of mouthparts modified for sucking or siphoning rather than for chewing. In these, the chewing elements are all present but are greatly elongated for probing and piercing and interlock in such a way as to form a proboscis or beak with a food channel, or canal, running through it. An added element is a pumping apparatus located farther back in the head or thorax which, through a system of valves and pressure chambers, promotes the flow of fluid (nectar, sap, blood, etc.) into the digestive tract. The general anatomy of sucking mouthparts is illustrated in Figure 2.

Internally, the head is nearly filled with the massive brain. An insect's brain functions much like our own, receiving external stimuli via the eyes and myriads of microscopic sensing structures located all over the body surface but which are especially numerous on the antennae, palpi (antenna like structures on the mouth parts) and tarsi (feet). The brain integrates these stimuli and initiates reactions to them which collectively form the animal's behavior.

Insects have a number of smaller, secondary or accessory "brains" (called ganglia) located along the central nerve cord which lies in the floor of the body cavity (Fig. 4). Each secondary brain assumes some of the duties of the true brain located in the head, and provides a degree of autonomy to the segment in which it lies. This explains the ability of an insect to live and move for some time after decapitation.

The thorax, or middle body region, bears the wings and legs, and thus is the center of locomotion. Internally, the thorax is nearly filled with the powerful muscles and large ganglia needed to operate and control these appendages.

Wings, which many insects lack and which are often greatly modified as in the hard, horny outer wings of beetles, but usually are broad, flattened, membranous structures. They are strengthened by a system of stout veins which diverge from the wing base and run throughout the membrane.

The legs, which are always six in number, are generally similar and are divided into four major

[1]Senior Curator of Entomology, Natural History Museum of Los Angeles County, Los Angeles, California 90007.

Figure 2. Major elements of insect mouthparts: chewing type (tiger beetle), left; sucking type (cicada), right.

sections roughly corresponding in function to our own leg regions (Fig. 3): a basal coxa with associated trochanter (hip); an elongate, heavy femur (thigh); a slender tibia (shin), and a terminal tarsus (foot). The tarsus itself consists of a varying number of smaller segments, the last of which is tipped with claws or other devices for securing the insect's hold on the substratum.

The abdomen contains vital organs concerned with digestion, excretion, blood circulation and reproduction. Respiration is performed by a network of tubes (tracheal system) ramifying throughout the body and opening to the atmosphere by means of breathing pores called spiracles (Fig. 3). Oxygen entering these breathing pores passes through the tracheal tubes directly to the tissues—it does not travel in the blood, as it does in our bodies.

Digestive processes of insects are similar to those in the vertebrate body. Food is broken down by digestive fluids in the stomach and intestine and passes in molecular form through the intestinal wall into the blood.

The blood circulates freely in the body cavity, bathing the tissues and organs with nutrients, hormones and other necessary substances. Thus, the insect circulatory system is of the "open" type, that is, there is no closed system of vessels through which the blood flows in a confined path. The only organ in the insect comparable to our own blood vessels is the so-called heart and its extension, the aorta (Fig. 4), which runs the length of the insect in the roof of the body cavity. Blood in the abdomen passes into the heart through perforations and is propelled forward to the head by pulsating contractions of muscles in the walls of the aorta. Flooding from this vessel in the vicinity of the brain, the blood percolates rearward through the entire body, including the legs and wings, to the abdomen, where it is again picked up by the heart. The cycle constitutes blood circulation.

Excretion of metabolic wastes is the job of the insect's kidneys, called Malpighian tubules. These organs are long, slender hollow tubes branching off the rear part of the intestine. The cells comprising their walls have the ability selectively to remove waste substances in solution from the blood and pass them to the intestinal cavity, from which they are later voided with the feces.

During the breeding season, the abdomens of females of many insects are nearly filled with eggs developing within the paired ovaries. As the eggs pass down the lateral ovarian ducts, they mature and are fertilized by the male sperm previously placed at mating time in a special side pouch off the main duct. Fertilization is almost universally internal among insects, although many species exhibit alternative devices, some even reproducing entirely in the absence of the male (parthenogenesis). The anatomical arrangement of the reproductive organs is illustrated in Figure 4.

Before leaving the subject of insect anatomy, the special nature of the external body wall or exo-

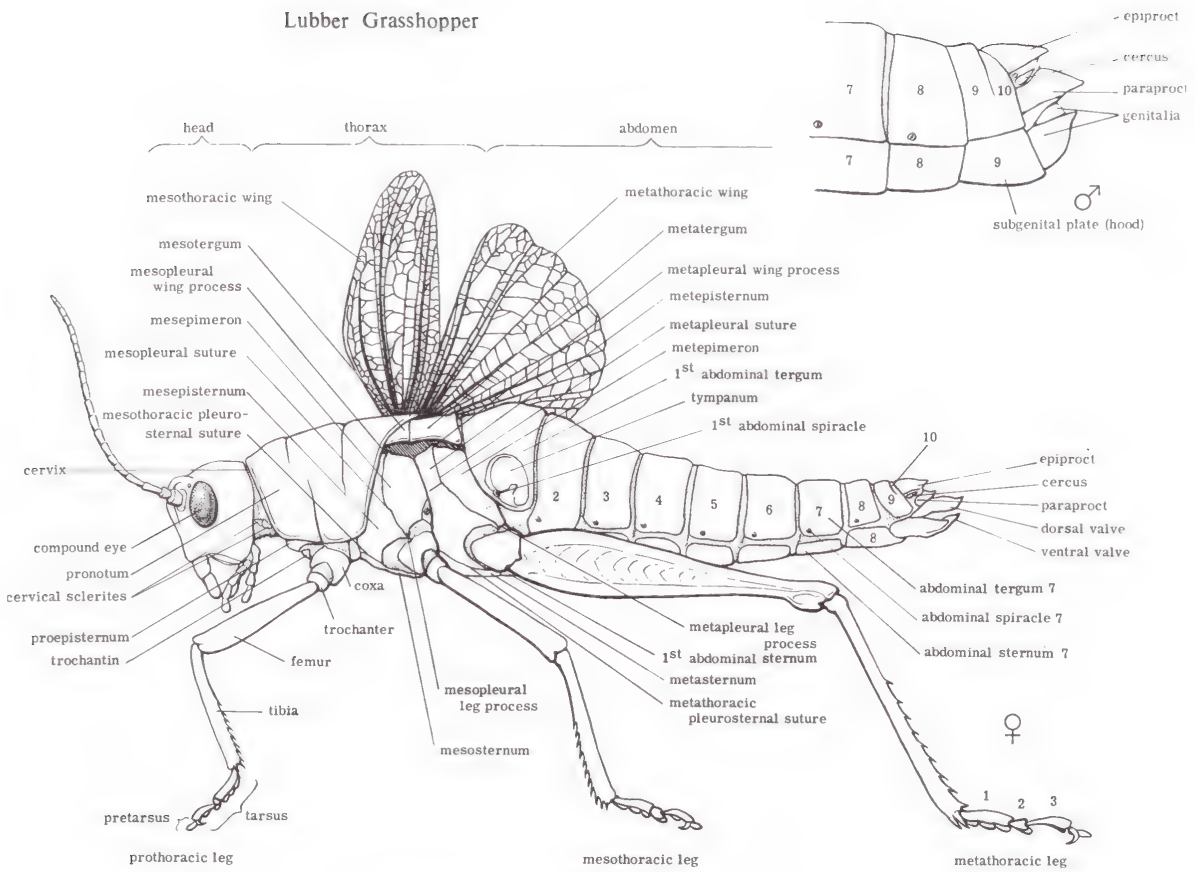


Figure 3. Principal external structures of a representative insect, the grasshopper. (From Belkin, J. 1972. Fundamentals of Entomology, p. 157)

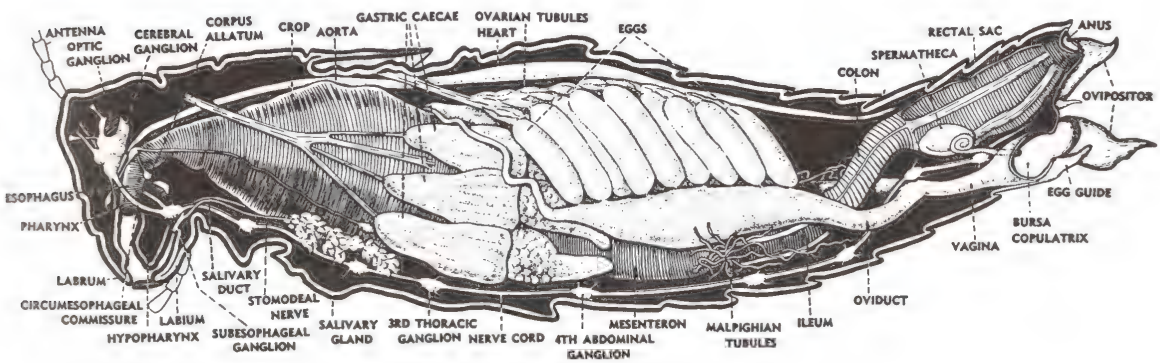


Figure 4. Principal internal structures of a representative insect, the grasshopper. (From Matheson, R. 1951 (Second edition). Entomology for introductory courses, fig. 51)

skeleton should be mentioned. The body wall is vested with a unique chemistry which places it among the toughest and most resistant of all natural products. A principle ingredient is chitin, a substance insoluble in most reagents, including dilute acids, alkalies and the digestive enzymes of other higher animals. Chitin does not give the body wall its rigidity, however. Another substance, called sclerotin, is responsible for this characteristic. The body wall functions most importantly as a protective covering (preventing loss of vital moisture and the entry of disease causing micro-organisms) and supportive skeleton (giving form to the body and providing a place for muscle attachment).

The body wall is firm and rigid only in certain areas. Membranous zones of soft tissue connect these rigid regions or plates (called sclerites) and permit movement between them. The total arrangement is something like the armor suits worn by knights of old.

INSECT GROWTH AND DEVELOPMENT

Like most animals, an insect begins its life as an egg. Insect eggs come in all shapes and sizes and are deposited in a wide variety of places: on the surface of leaves; in and on twigs; between flower petals; in the ground; in water, etc., and always in the near vicinity of a food source for the newly hatched young. Within the egg shell a period of embryonic development occurs that is analagous to that in the egg of a bird or reptile. The young insect hatches by eating an opening in the shell or by splitting the egg along some predetermined line of weakness.

A period of phenomenal growth follows hatching. Before reaching maturity, the young insect may increase its size and weight many times. Growth does not proceed evenly and continuously at it does in mammals. Rather, because the body wall is nonliving, steady enlargement can continue only to the point to which the skin may stretch no more. Then, to allow for a further increase in size, the unrelenting skin must be shed by means of a process called molting. Young insects usually molt a number of times on their way to maturity.

As it approaches adulthood, along this series of growth increments, the developing insect may alter its body form and habits, a phenomenal process of change known as metamorphosis: the degree of change may be radical, as exemplified by the butterflies and moths with wormlike caterpillar and mummylike pupal stages (Fig. 5a); relatively slight, as exemplified by true bug nymphs (Fig. 5b); or essentially non-existant, as in the silverfish whose young differ very little from the adult except for size (Fig. 5c). Insects belonging to the first category are said to experience *complete metamorphosis,* those of the second category *incomplete* or *gradual* metamorphosis, and those in the third group are considered to have no metamorphosis at all (*"ametamorphosis"*). The major differences between the types of metamorphosis and the orders of insects belonging to each are summarized in the following outline:

I. Complete metamorphosis: Extreme change in body form and habits during development; wings (when present) develop internally within the larval stage.

4 stages present:
egg→larva (caterpillar, grub, maggot, etc.)→ *pupa* (chrysalis)→*adult*
Important insects included:
Ants, bees and wasps
Beetles
Fleas
Gnats and flies
Butterflies and moths
Caddisflies
Lacewings, ant lions, etc.

II. Incomplete metamorphosis: Moderate change in body form and habits during development; wings (when present) develop externally in pads or pouches on the nymphal stage.

3 stages present:
egg→nymph→adult
Important insects included:
Thrips
True bugs
Sucking and biting lice
Bark lice
Termites
Grasshoppers, cockroaches, mantids, walking sticks, etc.
Earwigs
Dragonflies and damselflies
Mayflies

III. No metamorphosis: Virtually no change in body form and habits during development; wings never present.

3 stages present:
egg→young→adult
Important insects included:
Silverfish
Springtails

As is true of man, insect growth processes are under the control and direction of hormones. These substances are internal secretions manufactured and released in special cells and organs in the insect's body and distributed to the target tissues via the blood. The balance of two hormones is responsible for maturation and molting: *neotenin* (juvenile hormone) inhibits maturation, *ecdysone* (growth and differentiation hormone promotes growth and molting of the immature insect and triggers the transformation to pupa or adult.

The seemingly impossible trick of shedding its skin is performed routinely by an insect through the following steps: (1) The old outer skin becomes detached from the inner new skin through the action of enzymes secreted by epidermal cells. These enzymes dissolve the lower layers of the discarded skin. (2) Internal pressure, exerted by the insect through writhing movements and increased body volume built up by swallowing air, causes the old

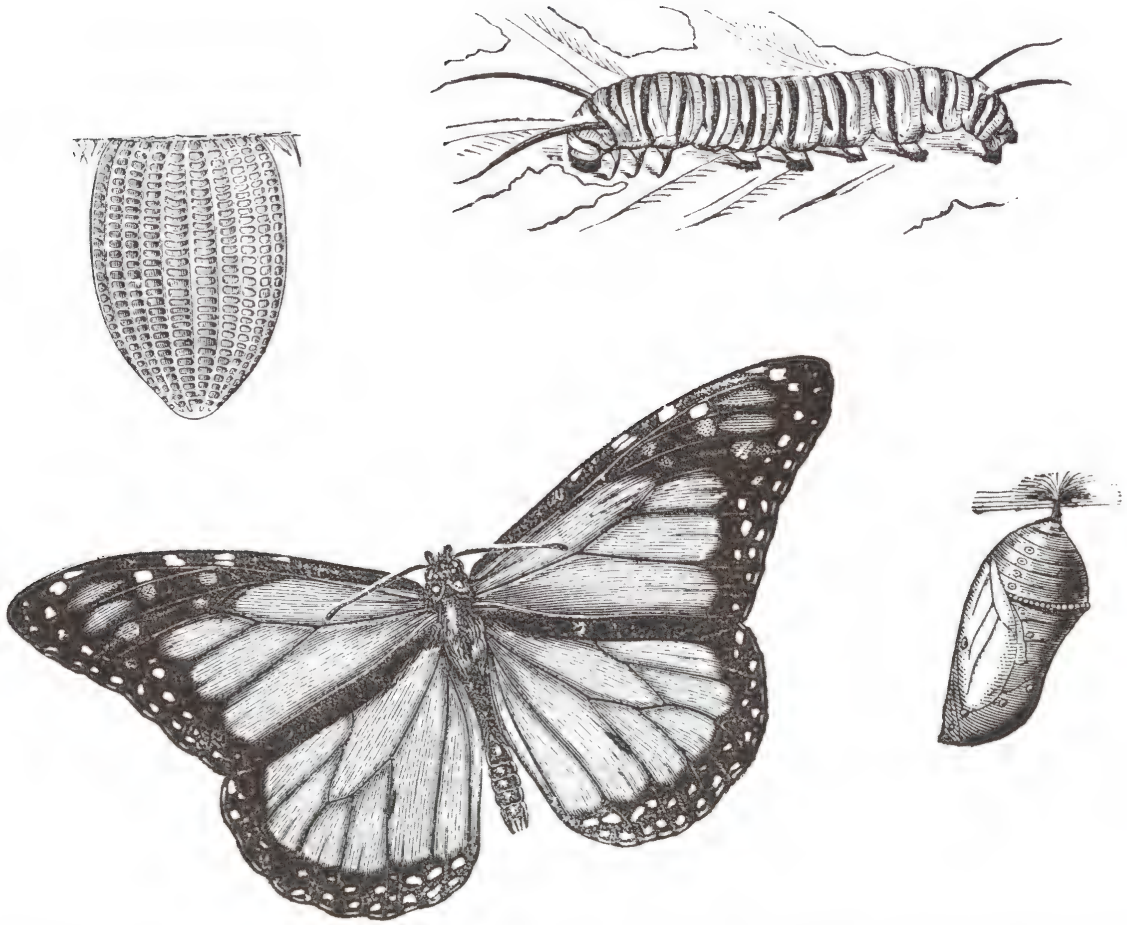


Figure 5a. Stages in insect metamorphosis: egg, larva, pupa, and adult of butterfly (complete metamorphosis). (From Riley, C. 1873. Canadian Entomol., vol. 5:5-8)

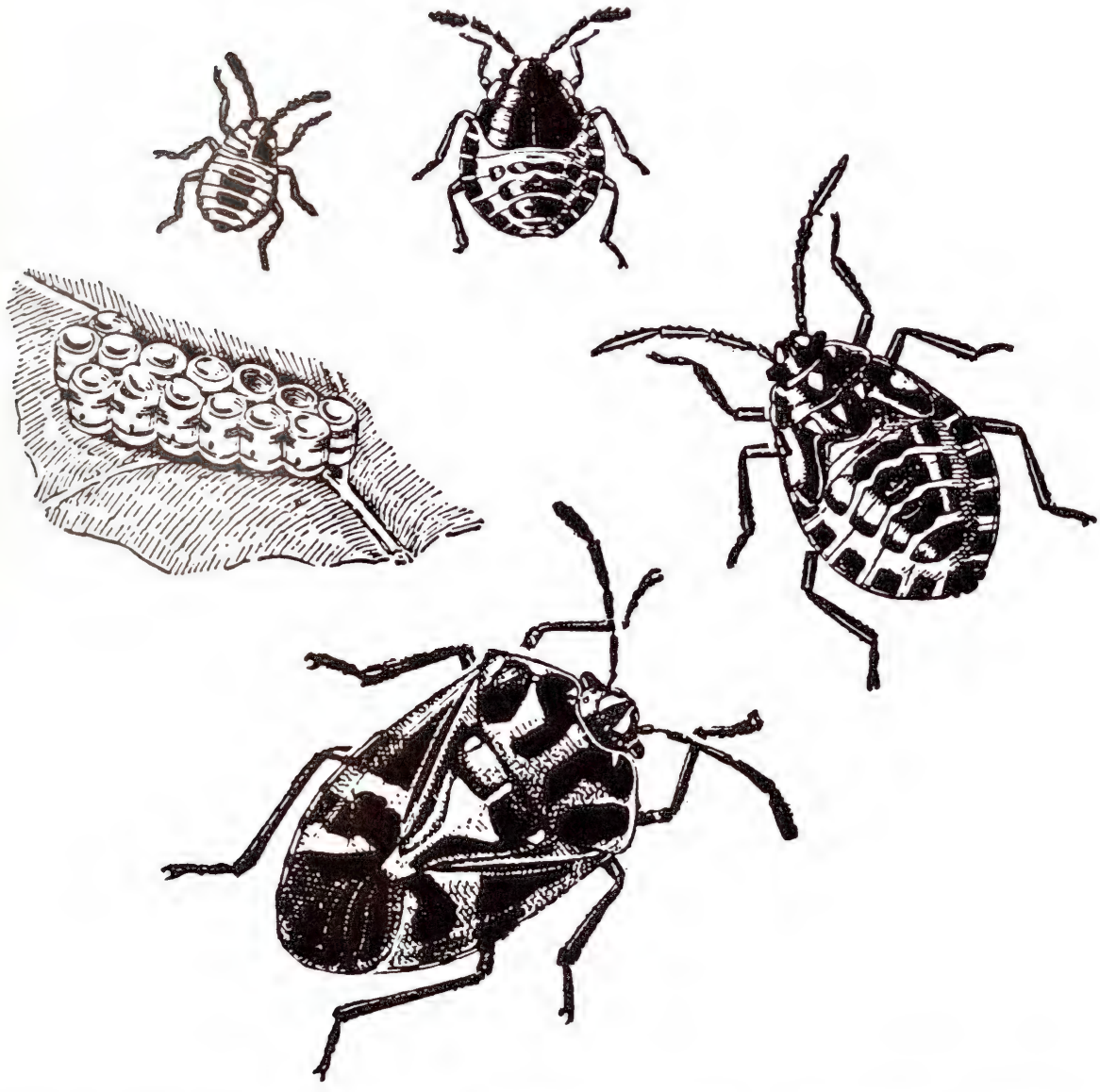


Figure 5b. Stages in insect metamorphosis: eggs, nymphs, and adult of true bug (incomplete metamorphosis). (From Chittenden, F. 1920. U.S. Dept. Agr., Farmer's Bull. 1061)

skin to split down the back. (3) The insect in its new skin wriggles through the fissure by degrees, stepping from the old skin as a farmer sheds his long underwear in the spring.

As a necessary preliminary to the molting process, the tips of the tarsi have been firmly implanted in the substratum. Consequently, the old skin remains anchored in place. Many insects spin a special silken pad to which their feet cling, in order to anchor the obsolete skin while it is being discarded.

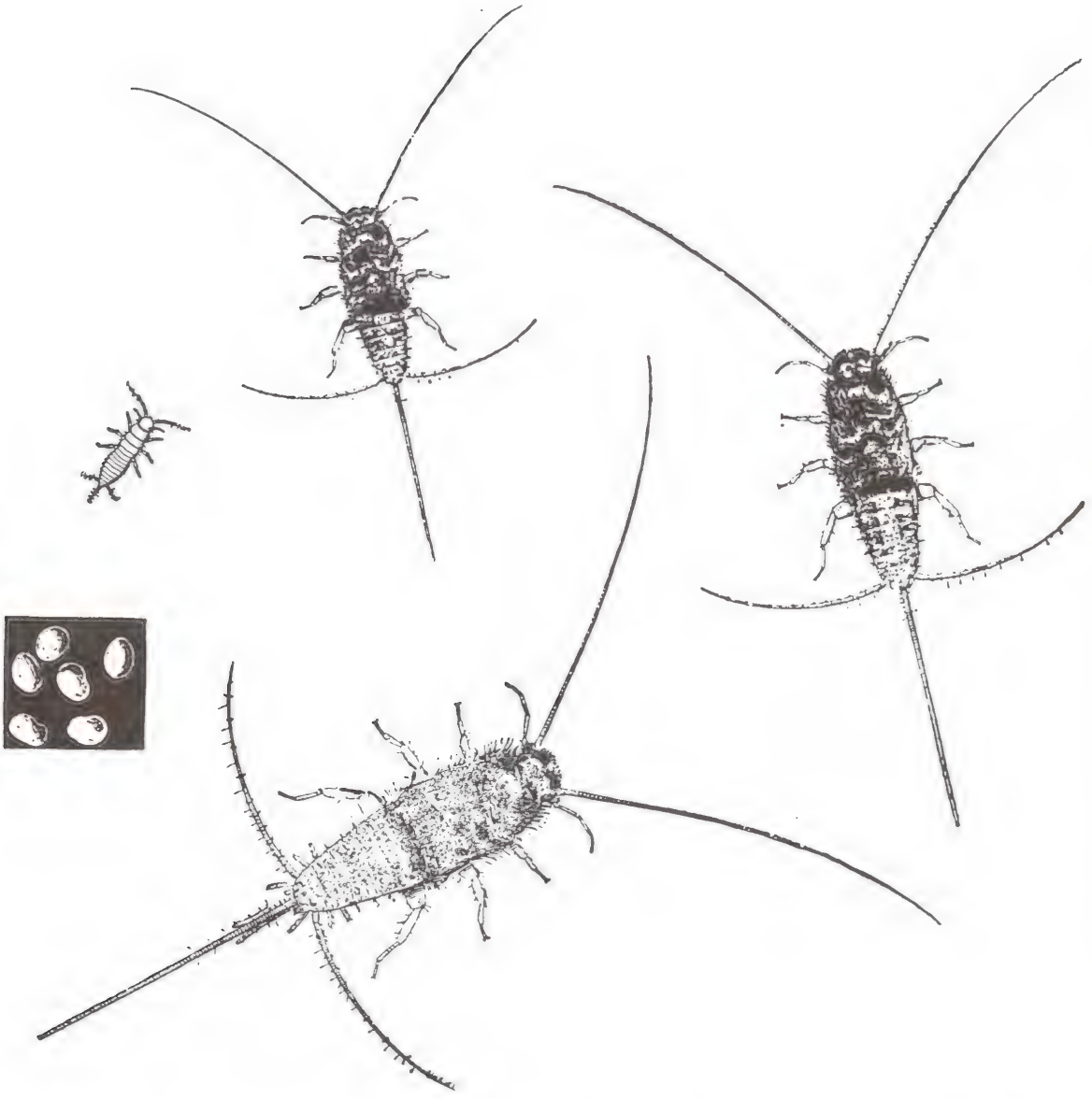


Figure 5c. Stages in insect metamorphosis: eggs, juveniles, and adult of silverfish (ametamorphosis). (From Metcalf, C. 1962 (Fourth Edition). Destructive and Useful Insects, fig. 5.8)

KEEPING INSECTS IN CAPTIVITY

To satisfy their curiosity about the habits and activities of insects or just to have an unusual pet, many people like to keep live specimens. For most species, this is easily done with much to be learned regarding feeding, life cycle, reproduction, and other aspects of the biology of our local insects.

For terrestrial types, some kind of cage is needed. Although a screen cage, cardboard carton or screened-over aquarium make better cages, a simple glass jar with holes punched in the lid will suffice. It is important in any case to follow a few simple rules regarding the proper care and feeding of the captives:

1. Provide good ventilation. Insects do not need much oxygen, but fresh air is required to control humidity and to prevent harmful growths of mold.
2. Offer water at regular intervals by sprinkling lightly or by placing in the cage a water-filled vial stoppered with a cloth wad.
3. Provide proper food in adequate amounts and keep it fresh. Remember that many species have very specific food requirements; these can be determined by using the literature or observing the insect under natural conditions. If the exact food is not known, generally successful substitutes are available as follows: for chewing, herbivorous types (not caterpillars)—fresh fruit slices or dog food; chewing, carnivorous types—mealworms or caterpillars; nectar feeding types—saturated sugar water on a cotton wad; sucking, herbivorous types—fresh prunes or raisins. Caterpillars need fresh leaves of their own foodplant.
4. Try to make the insect's surroundings conform as closely as possible to the type of environment in which it was found. For example, for light-shy types provide rocks under which they can hide, damp soil for burrowers, twigs or other supports for climbers.

Except for types requiring rapidly flowing water, aquatic insects are cared for much like tropical fish. Temperature control is not usually a factor, but it is important to keep the water level low to provide space for those types that metamorphose into flying adults. Food requirements are generally not as restrictive as with terrestrial types: a piece of beef or bacon tied to a string and suspended in the water satisfies gnawing carnivores; those requiring living prey will take mosquito larvae or minnows; green algal masses and common aquarium plants will do for most herbivores.

An excellent book, with specific instructions on how to maintain insects in captivity, is Siverly, R. 1962. Rearing Insects in Schools. W. C. Brown Co., Dubuque. Special instructions for mantids, caterpillars and ants are given in this book in the sections pertaining to these types.

MAKING AN INSECT COLLECTION

Insect collecting is not only an excellent learning experience for the serious entomology student, but it is an exciting, healthful and satisfying hobby for anyone. Owing to their enormous variety (the world's species are more than twice the number of postage stamp designs), new additions to the collection are possible endlessly.

To be more than a helter-skelter assemblage of "dead bugs," a collection must be properly prepared and cared for. The following instructions will serve the beginner, but after a little experience is gained the collector should refer to the references cited at the end of this section.

Collecting activities fall into four categories: 1. finding the specimens, 2. catching them, 3. keeping them temporarily in the field and 4. providing permanent storage.

Finding material requires only diligence and a sharp eye, for insects occur virtually everywhere. The twenty-selected microhabitats of insects listed on page 18 indicate the kinds of places that should be searched. An excellent way to obtain night flying insects is to take advantage of their tendency to be drawn to lights. An outdoor porch light, street lamp or Coleman lantern set on a bed sheet on the ground may yield hundreds of specimens. Most collectors nowadays use a special ultra-violet light ("Black Light," GE "BL"-15 watt, unfiltered, fluorescent tube) which is particularly attractive to nocturnal species.

To snare specimens, the human forefinger and thumb are the best instruments. However, for fast flying and stinging species a net is essential. Many kinds of nets are available; a simple one is made of a bag of curtain material sewn to a wire coat hanger which has been bent out into a circle and wired to a handle. The bag should be deep enough to fold completely across the face of the ring, in order to leave a small pocket in which the specimen is trapped. For aquatic insects a small dip net (such as used in tending aquaria) or wire kitchen strainer is useful.

Captured specimens are removed from the net with fingers or coaxed directly into the killing bottle. The latter works best if potassium cyanide crystals are used as the killing agent. However, because this is such a dangerous material, safer chemicals may be preferred, especially for children. Very good killing bottles are made by pressing a layer of cotton into the bottom, covering it with a disc of cardboard, and soaking it with ethyl acetate, finger-nail polish remover or lacquer thinner, volatile fluids capable of killing insects but which are safe to handle.

After the specimen dies it should be removed from the jar and stored in a safe place until it can be mounted. For this purpose many collectors use glassine envelopes kept in a cardboard box. A day's catch should be mounted the same evening. Dead insects quickly dry and become quite brittle and must be relaxed in a humidifier (moisture box) before they can be handled. The latter is made simply from a plastic or glass box (sandwich boxes, refrigerator dishes) by covering the bottom with a pad of thoroughly damp (but not dripping wet) towelling paper. Leave the dry specimens in the chamber one or two days. Mold may be inhibited by keeping the box in the refrigerator or by adding two or three drops of carbolic acid to the paper pad.

Mounting procedures vary according to the kind of insect. Most larger specimens are pinned directly with special steel pins ("insect pins," sizes # 1-3), leaving about 3/8 inch below the head as finger room for holding the specimen. Tiny specimens are glued to the tip of a small triangle of paper pierced at the broad end by a #3 insect pin. Soft-bodied types are killed and preserved permanently in alcohol (ordinary rubbing or isopropyl alcohol is good). The wings of butterflies and moths are spread (requiring special mounting boards and technique described in the references cited below).

Pinned and mounted specimens require no preservation treatment other than thorough drying. Never spray them with plastic fixatives or lacquers; this is unnecessary and obscures anatomical details. Kept dry and free of pests in a tight box with a few moth crystals (para-dichloro-benzene), a collection of dried insects will last indefinitely.

One important matter remains in the preparation of a collection—the data. Specimens without information relating to exact place, date and circumstances of capture are of little value. The accepted procedure is to print this information finely and carefully with India ink onto a small piece of heavy

paper (dimensions no greater than 1/2 inch by 1/3 inch) and place it on the pin beneath the insect.

Equipment and supplies for collecting may be purchased from the following sources in California: BioQuip Products, P. O. Box 61, Santa Monica, 90406; Ward's Natural Science Establishment, Inc., P. O. Box 1749, Monterey, 93940; Student Science Service, 3313 Glendale Blvd., Los Angeles, 90039.

REFERENCES: Ward's Natural Science Establishment, Inc. 1967 (Revised edition). How to Make an Insect Collection. Ward's Natur. Sci. Estab., Rochester.

Oman, P. 1948. Collection and Preservation of Insects. U. S. Dept. Agr., Misc. Pub. 601.

FINDING OUT MORE ABOUT INSECTS

This book will answer only some of the common questions about the insects of the Los Angeles area. Undoubtedly, readers will have many questions concerning the biology of specific insects, control problems, or other aspects of the subject of entomology. Several sources of information are available to answer these needs:

Books and other Literature

In addition to these references, there are others cited in the text. Following is a bibliography of the most useful references dealing with various facets of the subject.

General

Farb, P. and editors of Life. 1962. The Insects, Life Nature Library. Time Inc., N. Y.

Imms, A. 1957. (Ninth edition). A General Textbook of Entomology. Methuen & Co., London.

Klots, A. and E. Klots. 1959. Living Insects of the World. Doubleday, Garden City.

Ross, H. 1965. (Third edition). A Textbook of Entomology. Wiley and Sons, Inc., N. Y.

Wigglesworth, V. 1964. The Life of Insects. World Pub. Co., Cleveland.

Identification

Borror, D. and D. DeLong. 1971. (Third edition). An Introduction to the Study of Insects. Holt, Rinehart and Winston, N. Y.

Borror, D. and R. White. 1970. A Field Guide to the Insects of America North of Mexico. Houghton Mifflin Co., Boston.

Brues, C., A. Melander, and F. Carpenter. 1954. (Second edition). Classification of Insects. Bulletin Museum Comparative Zoology, Harvard, vol. 108.

Essig, E. 1958. (Second edition). Insects and Mites of Western North America. Macmillan, N. Y.

Jaques, H. 1947. (Second edition). How to Know the Insects. W. C. Brown Co., Dubuque.

Zim, H. and C. Cottam. 1951. Insects, Golden Nature Guide. Simon and Schuster, N. Y. (Other titles in this series: Butterflies and Moths; Insect Pests; Spiders and Their Kin).

Special Topics

Chapman, R. 1971. (Second edition). The Insects, Structure and Function. American Elsevier Pub. Co., Inc., N. Y.

Chu, H. 1949. How to Know the Immature Insects. W. C. Brown Co., Dubuque.

Cooper, E. 1963. Insects and Plants, the Amazing Partnership. Harcourt, Brace & World, N. Y.

Michener, C. and M. Michener. 1951. American Social Insects. Van Nostrand, Inc., Toronto.

Snodgrass, R. 1935. Principles of Insect Morphology. McGraw Hill, N. Y.

Sterling, D. 1954. Insects and the Homes They Build. Doubleday, Garden City.

Usinger, R., Ed. 1956. Aquatic Insects of California. University of Calif. Press, Berkeley.

Wigglesworth, V. 1973. (Seventh edition). The Principles of Insect Physiology. Methuen, London.

Pests (Including Control)

Carson, R. 1962. Silent Spring. Houghton Mifflin Co., Boston.

Ebeling, W. 1959. Subtropical Fruit Pests. University Calif. Division Agricultural Sciences, Berkeley.

Graham, F. 1970. Since Silent Spring. Fawcett World, Greenwich, Conn.

James, M. T. 1969. (Sixth edition). Herms's Medical Entomology. Macmillan, N. Y.

Mallis, A. 1967. (Fifth edition). Handbook of Pest Control. MacNair-Dorland Co., N. Y.

Metcalf, C., W. Flint, and R. L. Metcalf. 1962. (Fourth edition). Destructive and Useful Insects: Their Habits and Control. McGraw Hill, N. Y.

Whitten, J. 1966. That We May Live. Van Nostrand, Princeton, N. J.

Further valuable sources are the innumerable circulars, pamphlets, bulletins, etc., published by the U. S. Department of Agriculture (available from Government Printing Office, Washington, D. C.), California Agricultural Experiment Station, Extension Service (University of California, Berkeley), Los Angeles County and local city agricultural and public health offices.

Insect study

Brown, V. 1968. How to Follow the Adventures of Insects. Naturegraph, Heraldsburg, California.

Cummins, K., L. Miller, N. Smith, and R. Fox. 1964. Experimental Entomology. Reinhold, N. Y.

Kalmus, H. 1960. 101 Simple Experiments with Insects. Doubleday, Garden City.

Tweedie, M. 1968. Pleasure from Insects. Taplinger, N. Y.

Insect Relatives (Spiders, etc.)

Cloudsley-Thompson, J. 1968. (Second edition). Spiders, Scorpions, Centipedes and Mites. Pergamon Press, N. Y.

Comstock, J. 1948. (Revised by W. Gertsch). The Spider Book. Comstock Press, Ithaca.

Kaston, B. and E. Kaston. 1972. (Second edition). How to Know the Spiders. W. C. Brown, Dubuque.

Levi, H. and L. Levi. 1968. A Guide to Spiders and Their Kin. (A Golden Nature Guide). Golden Press, N. Y.

Savory, T. 1964. Arachnida. Academic Press, London.

Entertaining

Clausen, L. 1954. Insect Fact and Folklore. Macmillan, N. Y.
Klots, A. and E. Klots. 1961. 1001 Questions Answered about Insects. Dodd, Mead and Co., N.Y.
Neider, C., Ed. 1954. The Fabulous Insects. Harper, N. Y.
Teale, E., Ed. 1949. The Insect World of J. Henri Fabre. Dodd, Mead and Co., N. Y.
Verrill, A. 1937. Strange Insects and Their Stories. Grosset Dunlap, N.Y.

Children's Books

Baranowski, R. 1964. Golden Bookshelf of Natural History, Insects. Golden Press, N. Y.
Conklin, G. 1966. The Bug Club Book. Holiday House, N. Y.
Griffen, E. 1967. A Dog's Book of Bugs. Atheneum, N. Y.
Rood, R. 1963. The How and Why Wonder Book of Butterflies and Moths. Wonder Books, N. Y. (Other titles in the series: Insects; Ants, and Bees).
Shuttlesworth, D. and S. Swain. 1959. The Story of Spiders. Doubleday, Garden City, N. Y.
Sterling, D. 1961. Caterpillars. Doubleday, Garden City.
Teale, E. 1953. The Junior Book of Insects. Dutton, N. Y.

Much of the above is considered technical literature and is not available in outlying branches of the Los Angeles City Library, County Regional and other local libraries. The main Los Angeles Library may have most of these references, but it will often be easier to consult a university, college or museum library.

Most of the books mentioned in this manual may be obtained or ordered from the Bookshop of the Natural History Museum, or any major book store (ask to have them special ordered if you cannot find them). Insect books may be ordered from the following major dealers: Antiquariaat Junk, Dr. R. Schierenberg and Sons B.V., Postbus 5, Lochem, Holland; E. W. Classey, Ltd., Park Road, Farringdon, Berkshire 5N7 7DR, England; Rudolph Sabbot, Natural History Books, 5239 Tendilla Ave., Woodland Hills, California, 91364; Henry Tripp, 92-06 Jamaica Ave., Woodhaven, New York, 11421; and Entomological Reprint Specialists, P. O. Box 77224, Dockweiler Station, Los Angeles, California, 90007. All but the last also stock large inventories of secondhand and out-of-print literature.

CONSULTANTS

Another way to answer a question is to ask a person who knows. A surprising number of public agencies in our area employ entomologists who are available for consultation.

General questions

(Information and identifications only, no control recommendations)

1. Section of Entomology, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, 90007.

2. Department of Biology, University of California, 405 Hilgard Avenue, Los Angeles, 90024.

3. Biology Departments, California State Universities, Los Angeles, Long Beach, Fullerton and Northridge.

4. Los Angeles County Department of Parks and Recreation, Nature Centers: McCurdy (Eaton Canyon), 1750 N. Altadena Drive, Pasadena, 91107; Placerita Canyon, 19150 Placerita Canyon Road, Newhall, 91321; Whittier Narrows, 1000 N. Durfee Avenue, S. El Monte, 91733.

Quarantine problems

1. Office of Plant Protection and Quarantine Against Public Health Insects, U. S. Dept. of Agriculture, 300 Ferry Building, Terminal Island, 90031. (State offices of plant quarantine at this address also.)

Questions on health and household pests

1. Specialized Services Division, Bureau of Environmental Sanitation, Los Angeles County and City Health Department, 313 N. Figueroa Street, Los Angeles, 90012.

2. Bureau of Vector Control, California Department of Public Health, 1449 W. Temple Street, Los Angeles, 90013.

3. Structural Pest Control Board, California Department of Professional and Vocational Standards, 107 S. Broadway, Los Angeles, 90012.

4. Local Mosquito Abatement District Offices: Western District, 12107 W. Jefferson Blvd., Culver City, 90230. Southeast District, 9510 S. Garfield Ave., South Gate, 90280. Orange County District, 13001 E. Garden Grove Blvd., Garden Grove, 92640. Compton Creek District, 1224 S. Santa Fe Ave., Compton, 90221.

Venomous insects, spiders, scorpions, etc.

1. Laboratory of Neurological Research, Los Angeles County General Hospital, 1200 N. State St., Los Angeles, 90033.

Agricultural and garden pests

1. Los Angeles County Agricultural Commissioner's Office, Laboratory Services Division (Entomology). 155 W. Washington Blvd., Los Angeles 90015.

2. County and State Arboreta and Botanic Gardens, 301 N. Baldwin Ave., Arcadia, 91006.

Food contamination by insects

1. Inspection Branch, Food and Drug Administration, U. S. Department of Health, Education and Welfare, 1521 W. Pico Blvd., Los Angeles, 90015.

ORGANIZATIONS

Personal contact with others interested in entomology is also useful. Locally, we have two societies dedicated to the study of insects.

Lorquin Entomological Society. Meets on 4th Friday evening of each month, except July, August and December; Sponsored by the Natural History Museum of Los Angeles County (contact for information). Open to persons of all ages interested in entomology, including amateur collectors, young and old.

Entomological Club of Southern California. Meets on first Fridays in March, June, September, and December at the Los Angeles County Arboretum, Arcadia (contact the L. A. County Agricultural Commissioner's office for further information). Concerned primarily with economic entomology.

INSECT CLASSIFICATION AND THE ORDERS OF INSECTS

As a result of organic evolution, all living insects are related by heredity, having descended in the past from varying levels of common ancestors. Thus, using the tools of paleontology, comparative anatomy, embryology, physiology, genetics, etc., a hypothetical diagram of decent (so called "phylogenetic or evolutionary tree") can be constructed. The linear clasification of the orders of insects that follows is a simplification of their evolutionary history; each order represents the tip of a branch on the "tree".

THE ORDERS OF INSECTS

Those orders in italics are not discussed in this book.

1. *PROTURA—Proturans. Microscopic soil inhabiting forms.*
2. COLLEMBOLA—Springtails.
3. THYSANURA—Silverfish.
4. *DIPLURA—Diplurans. Small, inconspicuous dwellers of damp places.*
5. EPHEMERIDA—Mayflies.
6. ODONATA—Dragonflies and Damselflies.
7. *PLECOPTERA—Stoneflies. Found near mountain streams; immatures aquatic.*
8. DERMAPTERA—Earwigs.
9. ORTHOPTERA—Grasshoppers, mantids, walkingsticks, etc.
   - Suborder: a. SALTATORIA—Grasshoppers, Crickets and Katydids.
   - b. BLATTARIA—Cockroaches.
   - c. MANTODEA—Mantids.
   - d. PHASMIDA—Walkingsticks.
10. *EMBIOPTERA—Webspinners. Inconspicuous ground dwellers.*
11. ISOPTERA—Termites.
12. *ZORAPTERA—Zorapterans. Rare, not found in the West.*
13. CORRODENTIA—Bark lice.
14. MALLOPHAGA—Biting lice, bird lice.
15. ANOPLURA—Sucking lice.
16. HEMIPTERA—True bugs.
17. THYSANOPTERA—Thrips.
18. NEUROPTERA—Lacewings and relatives.
19. *MECOPTERA—Scorpionflies. Not found in the Basin.*
20. TRICHOPTERA—Caddisflies.
21. LEPIDOPTERA—Butterflies and moths.
22. DIPTERA—Gnats, flies.
23. SIPHONAPTERA—Fleas.
24. COLEOPTERA—Beetles.
25. *STREPSIPTERA—Twisted-wing insects. Rare, parasitic.*
26. HYMENOPTERA—Ants, bees and wasps.

RELATED TERRESTRIAL ARTHOPOD GROUPS

Often mistaken for insects.

A. Class ARACHNIDA
   1. Order SCORPIONIDA—Scorpions.
   2. Order SOLPUGIDA—Sun spiders.
   3. Order PHALANGIDA—Daddy-long-legs.
   4. Order ARANEIDA—Spiders.
   5. Order ACARINA—Mites and Ticks.

B. Class CHILOPODA—Centipedes.

C. Class DIPLOPODA—Millipedes.

D. Class CRUSTACEA
   1. Order ISOPODA—Sow bugs, etc.
   2. Order AMPHIPODA—Sand hoppers, etc.

PLATE I

1. Green Lynx Spider, female.

5. Harlequin Bug.

2. Caddisfly (*Hesperophylax*).

6. Giant Crane Fly.

3. Tachinid fly.

7. Spotted Halisidota, larva.

4. Common Milkweed Bug.

8. June Beetle (*Polyphylla*).

PLATE II

9. Fig Beetle.

13. Chalcedon Checkerspot, pupa.

10. Red Jumping Spider.

14. Silvestri's Scorpion.

11. Ceanothus Silk Moth, male.

15. Snowy Tree Cricket, male.

12. Rose-winged Grasshopper, nymph.

16. Milkweed Borer.

THE ENVIRONMENT

Topography

The greater Los Angeles area (Fig. 1) is accurately described as a basin—a complex depression circumscribed by high mountains to the north (San Gabriels), northwest (Santa Susanas) and southeast (Santa Anas), and the Pacific Ocean to the south and west. The only gaps in its periphery are the narrow eastern mouth of the San Gabriel River Valley and the southeastern coast line.

A complicated system of mountains and hills divides the basin into three subbasins—the Los Angeles Plain, the San Fernando Valley and the San Gabriel Valley. The most prominent barrier is the Santa Monica chain, rising highest in the west and declining eastward as the Elysian Hills. The Los Angeles River neatly terminates the latter with a sharp incision and delimits the Repetto and San Raphael Hill systems to the east. Completing the fragmentation of the greater basin to the east are the Puente Hills, San Jose Hills and Santa Ana Mountains. Otherwise flat or gently sloping to the sea, the monotony of the basin floor is broken only by minor prominences (Baldwin Hills, Dominguez Hills, Signal Hill).

Numerous small streams cut impressively steep canyons in the San Gabriels and Santa Anas, and merge into three major river systems, the Los Angeles (with the Rio Hondo tributary), the San Gabriel (with Big Dalton and Coyote Creek tributaries), and the Santa Ana Rivers. None of these channels carries a sizable flow during most of the year but may develop raging torrents during winter downpours. Broad alluvial flood plains spreading over the floor are evidence of the disruptive force of water falling on the 4-5 thousand-foot ridges of the San Gabriels (at the phenomenal rate of up to an inch an hour) and rushing to the sea only 40 miles distant.

Insect Habitats and the Ecology of the Basin

Microhabitats vs. macrohabitats. Insects are small animals and are thus profoundly affected by changes in their environment. The climate only indirectly influences the activities of insects through its modifying effects on the immediate environment. The immediate environment is composed of all the variables of temperature, moisture, space, food, etc. which specifically affect the insect's life and thus delimit its "home" or place of residence in the world. This place is usually referred to as the insect's *microhabitat*.

Conditions in a particular microhabitat may differ greatly from those in the general surroundings or *macrohabitat*. For example, minimum winter temperatures 7 to 10 inches deep in loamy soil, a microhabitat of many insects, have been shown to average higher than the air temperature above. The significance of this is greatest when the differential is between subfreezing in the air, and above-freezing in the soil. It is easy to see how this physical fact may prohibit or permit the insect's winter activity or very life.

Because of this fact, insects frequently live comfortably in microhabitats completely surrounded by decidedly hostile general environments. Consider, for example, the desert, with summer air temperatures of 130°F. and humidity below 1%, where soft bodied, moisture-loving larvae of the Cactus Fly (*Volucella mexicana*) could not survive were it not for the cooler, more humid interior of rotting cactus stems, which provides them with a suitable breeding habitat in an otherwise inhospitable environment.

Additional examples of insect microhabitats are given below. They are the places where one must look to collect specimens and observe the marvels of adaptation so characteristic of this class of animals. The list could be amplified almost indefinitely; twenty selected examples will suffice to show the variety possible:

Twenty Selected Examples of Insect Microhabitats of the Los Angeles Basin.

1. On the exposed surface of leaves[1], e.g. aphids.

[1]Many of these examples could be made more specific. "On the surface of leaves" could be divided according to the kind of plant, location of leaf on plant (upper or lower surface), and so on.

2. In contact with the ground under stones and boards, e.g. ground beetles.

3. Among the hairs on bodies of mammals, e.g. Cat Flea.

4. Among feathers on the bodies of birds, e.g. Slender Pigeon Louse.

5. Within the tubular flowers of many plants, e.g. Thrips.

6. Within tunnels chewed in dead, decaying wood, e.g. Pacific Dampwood Termite in pine logs.

7. Beneath the surface of loamy soil, e.g. Jerusalem Cricket.

8. In the bottom mud of stagnant ponds, e.g. water midge larvae.

9. Attached to surface of rocks in swiftly-flowing streams, e.g. larvae of black flies.

10. Within the flesh of fresh carrion, e.g. maggots of the Flesh Fly.

11. Within the flesh of old, dry carrion, e.g. larvae of dermestid beetles.

12. Within tunnels bored in the stems of living plants, e.g. larvae of the Yucca Weevil.

13. Among the hairs on your head, e.g. Human Louse (Let's hope not!).

14. In your hair follicles, e.g. Hair Follicle Mite.

15. Under the kitchen sink, e.g. Oriental Cockroach.

16. Under the trunk bark of a dead, rotting oak tree, e.g. Ironclad Beetle.

17. In fresh cattle droppings in a pasture, e.g. larvae of Drone Fly.

18. On the surface of still ponds, e.g. Common Water Strider.

19. In pools of crude oil near oil derricks and natural oil seeps, e.g. Petroleum Fly.

20. In rotting kelp on the beach, e.g. Stable Fly larvae.

The macrohabitats of insects are not as diverse nor as numerous as the microhabitats, because the factors of climate, soil, terrain, vegetation, surface water, and human activity which determine their boundaries vary over relatively broad geographic areas.

The direct effects of these conditions, though usually of general influence, sometimes exact very important specific effects on insects. The life cycles of almost all species are controlled by *climatic* factors, principally temperature and moisture. Sharp temperature and humidity variations resulting from Santa Ana winds may trigger emergence of some forms (Owlet Moths); the first winter rains definitely bring out others (Rain Beetles). Smog may even disturb insects as well as humans, but there is no scientific knowledge about this factor as yet. Differences between our climate types (Maritime, Intermediate Valley, Mountain and Transitional) are not extreme, and there are few insects limited to any of them: most distinctive perhaps is that of the mountains (Santa Monica Mountains and San Gabriel slopes and foothills), since these areas tend to have appreciably higher rainfall than the others.

Apart from special types such as tidal marsh, alkali, riverwash etc., there are four major types of *soils* in the Basin, classified according to origin: Residual Soils derived from the disintegration and weathering in place of consolidated rocks (decomposed granite); Old Valley-filling and Coastal Plain Soils derived from old sedimentary deposits that have been weathered; Recent Alluvial Soils derived from material transported from the various drainage basins; and Wind-laid Soils derived from beach sands blown inland in dunes. Most of our insects are not influenced by soil conditions except indirectly, in that soil conditions dictate the various types of vegetation. Yet there are species with narrow tolerances of variables in the subterranean realm. Many underground species require soil of sufficiently pliable texture or moisture-holding capacity to permit burrowing (Jerusalem Cricket, Trap-door Spider). Generally, our soils are light-colored, low in organic and mineral content and without profile, with scarce or no vegetable litter except in Riparian and Oak-Woodland Canyons. Consequently, the rich fauna typical of humic forest floors (springtails, mites, etc.) is absent or poor in diversity.

Standing and running *surface water* is scarce except in impoundments. There are several artificial lakes (reservoirs), but their insect fauna is depauperate since most are either paved or lack emergent shore vegetation. Our streams and rivers are, for the most part, intermittent, flowing only during the rainy months and then with scouring velocity. The best natural ponds and streams for supporting insect life are in the Santa Monicas and San Gabriel foothills. Once numerous artesian wells, sloughs and marshes, (Nigger and Bixby Sloughs, Bouton Lake) and estuary salt marshes, (Alamitos Bay, Bolsa Chica Bays), have been virtually destroyed by land fill and buildings. They were the habitat of many of our insects now locally extinct or rare.

Terrain has little immediate effect on our insects, although indirectly, of course, it is an important modifier of climate. The distribution of landforms in Los Angeles and vicinity is shown in Figure 1.

The hilly and mountainous regions of the Basin are presently richest in insect diversity and abundance, mainly because they have remained relatively free of human disturbance. Vestiges of natural surroundings still persist here and there, but are even now coming under the modifying influence of property development.

Of all environmental pressures, *human activity* has had the most profound effect on the insect fauna of the Basin. Urban density is constantly increasing, and natural areas are disappearing under asphalt and concrete. In the face of this accelerating trend, species are succumbing one by one. Eventually, our only insects will be those that live in our homes or are adapted to the conditions created as a result of human activity. Our only herbivores will be those which feed on agricultural, ornamental or weed plants; our only parasites and carnivores will be those that prey on those herbivores, on our pets, or on ourselves, and we will have practically no aquatic forms. From time to time a few native species will wander into the Basin from the neighboring hilly, mountainous or desert areas. Perhaps a few of those indigenous and precariously adapted species of special beauty or interest, such as the Western Short-horned Walkingstick, the Yucca Moth or the Pygmy Blue Butterfly will be conserved in nature parks.

None of the components of the environment discussed above directly limit the occurrence of any species. Rather, it is the combination of all of them which defines the macrohabitats of the Basin and influences the distribution of plants, humans and insects.

This jigsaw pattern of macrohabitats may be classified as follows:

Insect Macrohabitats of the Los Angeles Basin.

I. *NATURAL.* Essentially undisturbed wild or native areas. The original soil and vegetation are still present. (Best characterized by use of the plant association system of Munz and Keck which, in part, is followed here.)

A. *Coastal strand*: Sandy beaches and dunes scattered along the coast. Low or prostrate, commonly succulent woody perennials: Shore Sandbur (*Franseria*), Saltbush (*Atriplex*), Iceplant (*Mesembryanthemum*), Shore Morning-Glory (*Convolvulus soldenella*).

Example: El Segundo Sand Dunes
Characteristic insect: Sand Wasp (*Bembix*)

B. *Coastal Salt Marsh*: Salt marshes along the coast, from sea level to 10 feet (being destroyed now). Low herbs or shrubs, commonly succulent: Inkweed (*Sueda californica*), Salt Grass (*Distichlis spicata*), Sea Heath (*Frankenia grandifolia*).

Examples: Alamitos Bay, Seal Beach inlets, Sunset Beach
Characteristic insect: Pygmy Blue (*Brephidium exilis*)

C. *Freshwater Marsh*: Inland bodies of standing or sluggish water, formerly numerous but now largely filled and destroyed. Tall rush vegetation: Tules (*Scirpus*), Bulrushes and Cat-tails (*Typha*), Sedges (*Carex*).

Example: Dominguez Lagoon
Characteristic insect: Giant Water Scavenger (*Hydrophilus*)

D. *Coastal Sage Scrub*: Clay slopes of higher inland hills and coastal mountains. Open growth of small shrubs: California Sagebrush (*Artemisia tridentata*), Black Sage (*Salvia mellifera*), California Buckwheat (*Eriogonum fasciculatum*).

Example: Verdugo Hills
Characteristic insect: Chalcedon Checker Spot (*Euphydryas chalcedona*)

E. *Chaparral*: Mountain slopes (mostly above 1000 ft. contour where it takes over from the Coastal Sage). Dense growth of tall, thick-leaved shrubs, especially Chamise (*Adenostoma*), Scrub Oak (*Quercus dumosa*), Wild Lilacs (*Ceanothus*), and Manzanitas (*Arctostaphylos*).

Example: Slopes of San Gabriel Mountains
Characteristic insect: Timemas (*Timema*)

F. *Southern Oak Woodland*: Inland valleys and canyons. Trees, especially Coast Live Oak (*Quercus agrifolia*), with grass beneath.

Example: Chevy Chase Canyon
Characteristic insect: California Oak Moth (*Phryganidia californica*)

G. *Grass-Herbland*: Scattered throughout region dominated by Coastal Sage. Although native perennial herbs (spring wild flowers) are present, they are outnumbered by introduced weedy annuals. Grasses are predominantly introduced species.

Example: The original type over most of what is metropolitan Los Angeles, now largely extinct
Characteristic insect: Band-wing Grasshopper (*Dissosteira*)

H. *Riparian* (*Streamside*) *Woodland*: Along streams and around ponds. Trees (especially sycamore, alders, maples, cottonwoods and bays). Herbaceous or shrubby undergrowth, Nettle, *Baccharis* and willow.

Example: Big Tujunga Canyon
Characteristic insect: Lorquin's Admiral (*Limenitis lorquini*)

I. *Dry River Beds*: Washes, arroyos and basins below slopes of San Gabriel Mountains may form another type if water is seldom present. Vegetation is partly riparian in nature, but very sparse—bare boulders, cobbles and sand predominating. During long, dry periods, Coastal Sage may infringe on this type and isolated chaparral species may occur.

Example: San Gabriel Wash

Characteristic insect: Velvet ant (*Dasymutilla*)

J. *Aquatic*: Streams, ponds and lakes. Yet unpaved waterways.

Examples: Arroyo Seco River above Devil's Gate Dam; Hansen Dam reservoir

Characteristic insect: Back Swimmer (*Notonecta*)

II. *ARTIFICIAL*: Areas disturbed to some degree by man.

A. *Untenanted Areas*: Vacant or with only transient human occupancy.

1. Vacant lots. Waste, fallow fields.
   Example: none necessary
   Characteristic insect: Painted Lady (*Cynthia cardui*)
2. Grass-covered hills (principally Wild Oats (*Avena fatua*) and other non-native grasses present). Some in use as grazing areas.
   Example: Repetto Hills
   Characteristic insect: Band-wing grasshopper (*Dissosteira*)
3. Flood control channels and basins.
   Example: Los Angeles River bottom
   Characteristic insect: Cool Weather Mosquito (*Culiseta incidens*)

B. *Agricultural and Horticultural Areas*: Cultivated and continually tended.

1. Planted fields, fruit orchards and nut groves.
   Example: none necessary
   Characteristic insect: Cutworm moths (Noctuidae)
2. Livestock farms and ranches.
   Example: none necessary
   Characteristic insect: Stable Fly (*Stomoxys calcitrans*)
3. Home and public gardens; commercial nurseries; greenhouses.
   Example: County and State Arboretum
   Characteristic insect: Broad-wing Katydid (*Microcentrum rhombifolium*)
4. Parks; golf courses; cemeteries.
   Example: Forest Lawn Memorial Park
   Characteristic insect: Fiery Skipper (*Hylephila phylaeus*)
5. Road and freeway embankments and shoulders.
   Example: none necessary
   Characteristic insect: Leafhopper (Cicadellidae)

C. Storage Areas: Lumber yards, granaries, warehouses, movie lots, dumps.

Example: none necessary

Characteristic insect: Oriental Cockroach (*Blatella orientalis*)

Although some tolerant species occur over the entire Basin, freely crossing the habitat boundaries, most are found in only one of these macrohabitats. Most herbivores eat only one of a few species of plants, and these are restricted to the community of which they are a part. This is why, for example, the California Sister butterfly lives only in the Riparian Woodland, because its food is the Canyon Oak (a typical member of that vegetation type). Carnivores and parasites, in turn, may prey on specific herbivores and likewise be limited to their ranges.

REFERENCES: Editors of Sunset Magazine and Sunset Books. 1967 (Third edition). The West's 24 climate zones. Pages 8-27 *in* Sunset western garden book. Lane Mag. and Book Co., Menlo Park, Calif.

Jaeger, E. and A. Smith. 1966. Introduction to the natural history of southern California. Univ. Calif. Press, Berkeley.

McEKevan, D. 1962. Soil animals. Philosophical Library, N. Y.

Munz, P. and D. Keck. 1959. California plant communities. Pages 10-18 *in* P. Munz and D. Keck, A California flora. Univ. Calif. Press, Berkeley.

U. S. Dept. Agriculture, Soil conservation service. 1969. Report and general soil map of Los Angeles County.

Yerkes, R., T. McCulloh, J. Schollhamer, and J. Vedder. 1965. Geology of the Los Angeles Basin California—an introduction. U. S. Geol. Surv., Prof. Pap. 420-A.

COMMON AND CONSPICUOUS

INSECTS

Springtails
Order COLLEMBOLA

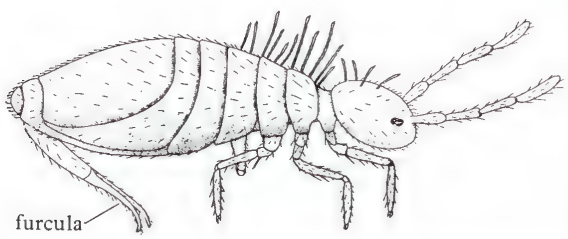


Figure 6. *Mesentotoma laguna*, an intertidal springtail. (From Bacon, G. 1913. J. Entomol. Zool., vol. 5:203)

These minute insects—most are only a millimeter or so in length—derive their name from their curious method of locomotion. Each is equipped with a tail-like appendage (Fig. 6, furcula) on the underside of the abdomen which, when suddenly extended, snaps against the substratum and propels the insect upward.

Springtails are usually seen when a group of them is uncovered under a board or rock lying on damp soil or plant litter. They resemble a troupe of dancing, hopping particles set in motion by the sudden exposure to light. In their jumping activity they resemble fleas.

Among the most numerous of animals found in the soil, springtails are also commonly encountered in compost piles, grass cuttings, under flower pots, in cellars, among stored plant bulbs, wherever it is humid and dark. On rare occasions, swimming pool owners may find large numbers floating in masses on the surface of the water. One peculiar species, *Mesentotoma laguna* (discovered at Laguna Beach), lives on rocks in the intertidal zone along the beach.

These insects are primarily vegetarians but seldom do any perceptible damage to gardens in our area.

Silverfish
Order THYSANURA

Figure 7. Urban Silverfish, adult.

The Common Silverfish (*Lepisma saccharina*), the Urban Silverfish (*Ctenolepisma urbana*) and the Fire Brat (*Thermobia domestica*) are the prevalent species in our area. Silverfish are easily recognized by the pair of long antennae on the head and three prominent filaments extending from the tail end. They are also known by their secretive habits. Ordinarily they are nocturnal and not seen during the daytime; but who has not had the experience of turning on a room light and seeing these insects scurry across a wall or over furniture?

The Common Silverfish and Urban Silverfish may be found in almost any warm, damp, dark place indoors or out. The Fire Brat prefers heated basements, steam tunnels, bakeries, boiler rooms or similar very warm (over 90°F.) locations, with an optimum preference just below 100°F. Both species have a taste for paper, especially that which contains sizing such as starch, gum or glue. For this reason, they may do damage around the home to wallpaper, books (especially the binding) and

other papers. Other items of which silverfish are fond are sugar, flour, breakfast cereals, fabric, insulating materials—almost any produce of plant or animal origin.

Silverfish feel slippery when caught between the fingers. This is due to a body covering of tiny flat scales (similar to those on the wings of butterflies) which rub off easily.

In addition to the three species mentioned above, at least two additional silverfish (*Neomachilis* and *Machilinus* species) occasionally enter homes in the Basin.

REFERENCES: Mallis, A. 1964 (Fourth edition). Silverfish. Chapter II *in* A. Mallis, Handbook of pest control. MacNair-Dorland Co., New York.

Smith, E. 1970. Biology and stucture of some California bristletails and silverfish Apterygota: Microcoryphia, Thysanura). Pan-Pacific Entomol., vol. 46, pp. 212-225.

Mayflies
Order EPHEMERIDA

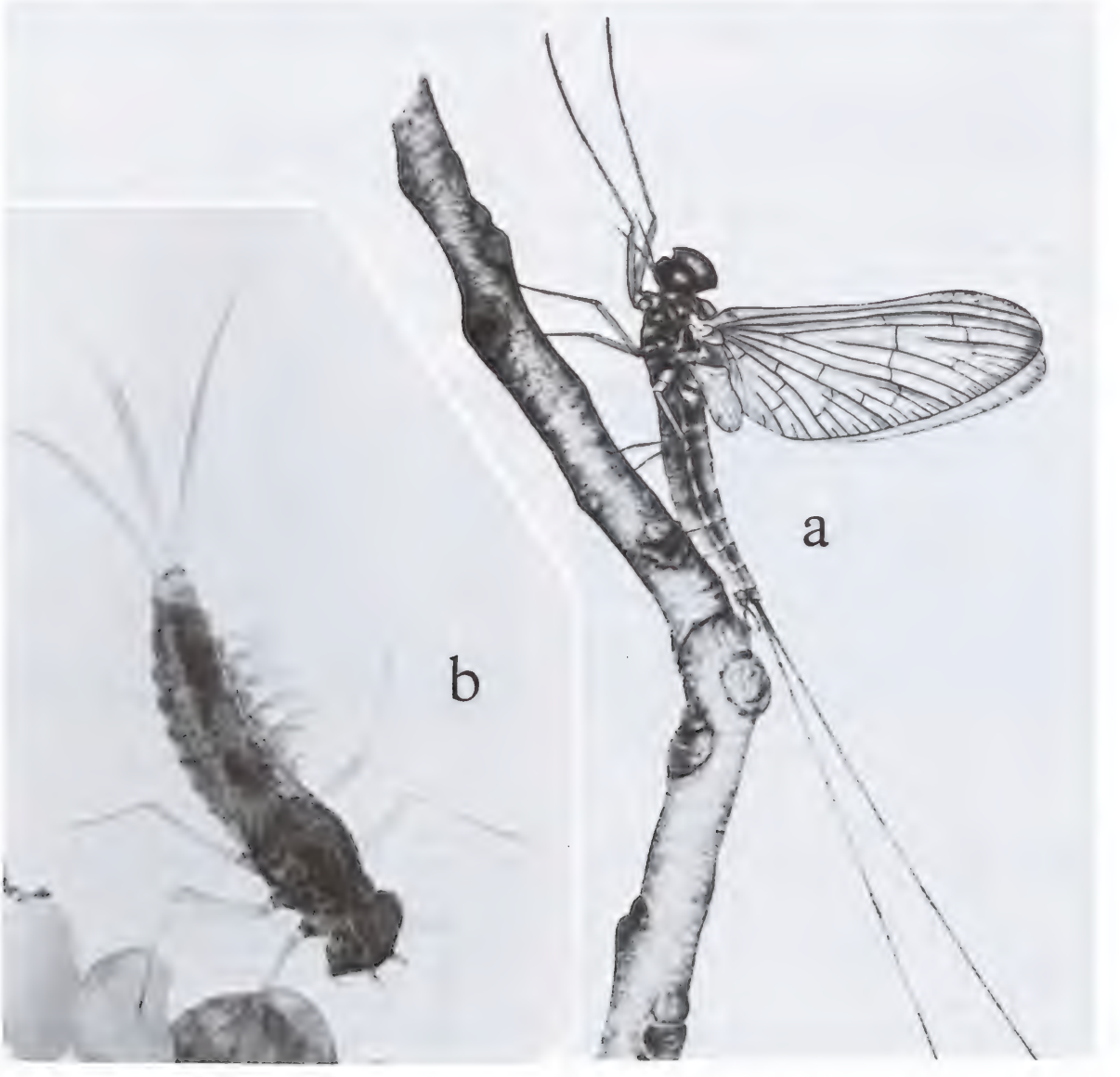


Figure 8. A mayfly (*Callibaetis*): a.—adult male, b.—immature (naiad). (a, From Berner, L. 1950. The Mayflies of Florida, pl. 20)

Not commonly seen in the Los Angeles Basin proper, mayflies belonging to several genera are plentiful enough near streams and ponds in the nearby foothills and mountains. The explanation lies in the fact that these insects are completely aquatic as immatures, and the weak flying adults never stray far from the water. Our only local species are small and belong to the genus *Callibaetis*.

The herbivorous nymps live in flowing or (more rarely) still water, on the bottom, on rocks, in moss, trash and other hiding places. Adults emerge first as dull colored forms with dark wings (subimagos) but soon change into the familiar glassy-winged, true adults. This is the only order of insects in which the molting process occurs in a winged stage.

Adults do not feed and live only a few hours or days at the most, hence the order name Ephemerida, from the Greek *ephemeros* (lasting but a short while).

Both mature and young mayflies may be considered beneficial in the "balance of nature," since the adults are important food for birds and other beneficial insects and the nymphs are eaten by fish.

Many dry and wet flies utilized by anglers are patterned after these insects.

Dragonflies and Damselflies
Order ODONATA

Like mayflies, dragonflies and damselflies live as immatures in water. But because they are stronger fliers, they are frequently seen long distances from the ponds, lakes and streams in which they breed.

Larger, more aggressive and conspicuous, dragonflies are better known than their smaller, timid and delicate close relatives, the damselflies. Their names bespeak of this difference. Dragonflies, or "dragons of the air," are also known colloquially as "devil's darning needles," "snake doctors" and "horse stingers." The first name is derived from their supposed ability to sew up the mouths of little boys who tell lies. Actually, of course, dragonflies can not sew, nor can they sting as the last name implies. A live specimen held between the fingers seems to be trying to sting when it coils its abdomen around, jabbing with the tip, but there is no stinging apparatus.

Dragonflies are extremely agile aeronauts, spending most of their waking hours in the air, patrolling pond or stream margins, darting low over the surface or high into the air. Most of this aerial energy is expended for the purpose of catching the small flying insects which are their food. This they accomplish by folding the legs in front and beneath the head in the form of a basket. The legs are useless for walking; at rest the dragonfly uses them only for clasping its perch. While engrossed in snatching prey from the air, these insect hunters may be fooled, momentarily, by a tossed small stone or wadded piece of paper. A rapid dive, however, reveals the ruse, and before they catch the object, they veer away.

The posture assumed by dragonflies and damselflies during copulation is unique (Fig. 9). It is maintained during flight and has moved casual observers of natural history to stories of "Siamese dragonflies." The genitalia of the males are located

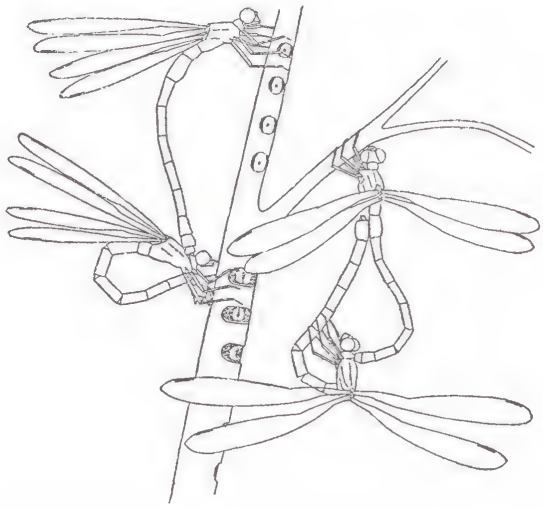


Figure 9. Damselflies, male and female in copulating attitude. (From Kennedy, C. 1916. Proc. U.S. Natl. Mus., vol. 49:264)

in a pocket on the underside of the second abdominal segment, not at the tip of the abdomen as in most other insects; during copulation, the male grasps the female behind the head with a pinching apparatus carried at the tip of the abdomen, and then she curls her abdomen forward to receive sperm from the male genitalia. It should be mentioned that the sperm have been previously placed in the anterior genital pocket by the male in a similar manner, by curling his abdomen forward and expelling them from the genital orifice.

The aquatic nymphs are as voracious predators as the adults, but their feeding method is very different. The prey, which consists of almost any small animal swimming closely enough, is captured by a swift strike with the jointed lower lip. The action is similar to that displayed by the toad or chameleon when seizing insects with their extendable, sticky tongues.

Man is a latecomer in the use of jet propulsion. By a forcible expulsion of water from the rectum these dragonfly nymphs drive themselves forward through the water at great speed. This method of locomotion is employed principally to evade enemies.

REFERENCE: Needham, J. 1955. A manual of the dragonflies of North America (Anisoptera). Univ. Calif. Press, Berkeley.

Dragonflies
Suborder ANISOPTERA

Of the several species of dragonflies found in the Basin the following are the most common:

Big Red Skimmer
(*Libellula saturata*)

Figure 10. Big Red Skimmer.

This is a conspicuous dragonfly because of its large size (body length 2-2½ inches) and orange-red color. The wings are usually bright red-orange over the entire basal half, although this color may be reduced to just the heavy veined area toward the front of the wings. The species is usually seen near sluggish streams and ponds flying strongly to and fro, "hawking" small insect prey. The large hairy nymph lives in the ooze on the bottom of stagnant pools.

Red-tinged Skimmer
(*Tarnetrum illotum*)

Figure 11. Red-tinged Skimmer.

This species is also reddish, like the preceding, but it is considerably smaller (body length about 1½ inches). The red-orange of the wings never consists of more than light basal streaks surrounded by a yellowish hue.

Pastel Skimmer
(*Tarnetrum corruptum*)

Figure 12. Pastel Skimmer.

A close relative of the above species and about the same size, this dragonfly is colored quite differently in soft pastel shades of yellow, red and olive. The oblique stripes on the side of the thorax are characteristically whitish in the middle, overlaid at the lower end by a yellow spot which is half encircled by black on the lower side. The wing membrane is clear.

This and the preceding species are weak fliers, compared to the following, and are often seen resting on vegetation even during the middle of the day.

Multicolored Darner
(*Aeschna multicolor*)

Figure 13. Multicolored Darner.

This is our largest local dragonfly (body length 2½ inches or more). It is predominantly blue in color and has clear wings. A strong flyer, it seldom comes to rest during the day and frequently forages far from water.

Damselflies
Suborder ZYGOPTERA

Ruby Spot
(*Hetaerina americana*)

Figure 14. Ruby Spot.

This species, although uncommon in our area, is mentioned because of its uniqueness. The wings of the males are conspicuously marked with a brilliant ruby or carmine basal spot; the spot is dull reddish or amber in the females. The Ruby Spot is likely to be seen only near rapidly flowing streams in the mountain canyons surrounding the Basin.

California Archilestes
(*Archilestes californica*)

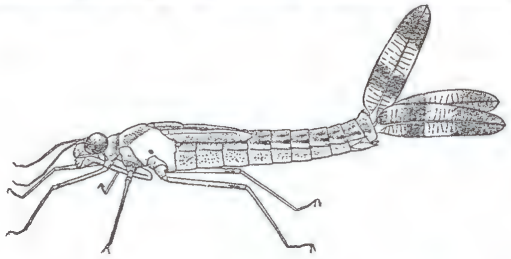


Figure 15. California Archilestes: a.—adult, b—immature (naiad). (b, From Kennedy, C. 1916. Proc. U.S. Natl. Mus., vol. 49:265)

It is possible to distinguish this species from the several other common damselflies of our area by its relatively large size (body length nearly 2 inches) and the fact that it rests with its wings outstretched like a dragonfly rather than folded back in normal damselfly fashion.

Our other common damselflies are brightly marked with blue and green and belong to the genera *Ischnura, Argia* and *Enallagma.* The species are difficult to distinguish.

Earwigs
Order DERMAPTERA

These insects are well known to those of us who have cleaned up lumber piles, rocks, or other

debris from vacant lots or back yards. They are usually found hiding under a stone or board lying on slightly damp soil and are easily recognized by the dangerous-looking pincers carried at the tip of the abdomen. Though these structures can give a mild nip, they are otherwise harmless. Their true function is unknown.

No one is quite sure how earwigs became so named. Probably the best guess is that the early Anglo-Saxons who named them *earwicga* (*eare* = ear and *wicga* = beetle, worm) and who lived in sod huts, where these insects also lived, occasionally found them in their ears on awaking from a sound sleep on a straw mattress. The warm and tidy ear opening of a slumbering person might well have been a comfortable hiding place for these crevice-loving creatures.

The following is our one common species although the European Earwig (*Forficula auricularia*) and the Maritime Earwig (*Anisolabis maritima*) also occur here.

Ring-legged Earwig
(*Euborellia annulipes*)

Figure 16. Ring-legged Earwing.

Not a native, this insect has immigrated from somewhere in the Old World where it is almost universally found. It is completely wingless (most earwigs have fully developed wings), has one or two light segments near the ends of the antennae and usually has dark brown spots or rings on the legs. Though omnivorous and sometimes an economic pest, it prefers an insect diet and in some cases may even be beneficial as a predator.

This earwig may exhibit maternal care. The female sits on her eggs like a brooding hen. If disturbed, she tries either to nip the intruder with her forceps or to run for cover, holding an egg in her mouth. Care of the young usually extends only to the second nymphal instar.

REFERENCE: Bharadwaj, R. 1966. Observations on the bionomics of *Euborellia annulipes* (Dermaptera: Labiduridae). Entomol. Soc. Amer., Ann., vol. 59, pp. 441-450.

Order ORTHOPTERA

The Jumping Orthoptera—Grasshoppers and their Relatives
Suborder SALTATORIA

This group of insects contains many familiar forms: grasshoppers, katydids, crickets etc.; all characteristically possess hind legs which are specially modified for jumping or leaping. The femora are swollen to accommodate greatly enlarged muscles which can powerfully kick the tibiae downward and backward, to propel the insect forward. This action is used principally by wingless species in a hurry to escape an enemy. Many Saltatoria also have wings and can escape in flight.

In addition to their jumping abilities the Saltatoria are noted for their musical talents. Who hasn't heard a cricket or a katydid singing through the summer night? These noises are not for the entertainment of man or the insect but serve a definite purpose in the insect's sexual behavior. The main function served is the meeting of the sexes.

The sounds are complex patterns generated by special anatomical structures called stridulatory organs. The body location of these structures generally varies according to the family of Saltatoria, and the quality of sound produced varies with the species. The wings and hind legs bear roughened areas which, when rubbed together, give off sounds ranging from a dull buzzing to high-pitched, trilled whistle.

It follows that, if the grasshoppers and their relatives make music with a purpose, they must also possess devices with which to hear it. The auditory organs ("ears") of these insects are well developed and consist of thin membranes connected to sensory nerves. They are located in various places on the body, but never on the head. These ears hear most of the sounds in the insect's environment but are especially tuned to the sound generated by the stridulatory organs.

Grasshoppers
Family Acrididae

Grasshoppers are characterized by their short antennae. The location of their auditory organs is also unique, being on either side of the first ab-

dominal segment. The stridulatory organs consist of tiny peg-like projections on the inner side of the hind leg. The resting grasshopper rubs these projections rapidly against the fore wing, causing the wing to vibrate and produce a buzzing sound. This buzzing sound frequently startles local hikers, who think they hear a rattlesnake. Some species also make a crackling sound during flight.

There are many species of grasshoppers in the Basin, but the following are most frequent:

Figure 17. California Rose-winged Grasshopper: a.—mounted specimen, b.—specimen at rest on normal background.

California Rose-winged Grasshopper
(*Dissosteira pictipennis*)

One of the so-called "band-wing grasshoppers," this species sports hind wings of bright red inside a black band. Other local band-wings, belonging to several genera and species, have hind wings colored yellow, blue or orange. The front wings are mottled, giving the hopper camouflage when resting on gravelly or sandy ground. Most band-wings make a crackling sound when in flight.

Gray Bird Grasshopper
(*Schistocerca vaga*)

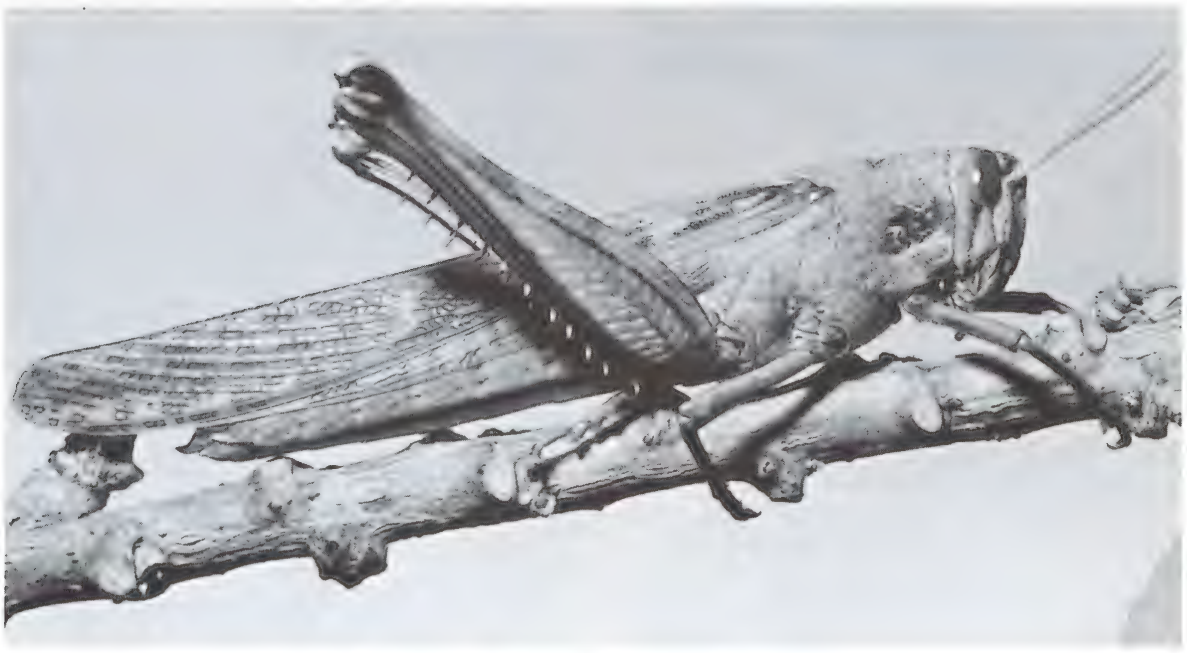


Figure 18. Gray Bird Grasshopper, female.

This is a very large species (females up to 2 inches) found fairly commonly feeding on garden shrubbery. It is gray or brownish in general color; the hind wings are uniformly transparent greenish.

Adults occur in the spring; the light green nymphs attain noticeable size in the late summer.

This species has several notorious relatives, for the genus *Shistocerca* contains the migratory locusts which have plagued man since the beginning of agriculture. The Old World Migratory Locust or Desert Locust (*S. gregaria*) was responsible for the Biblical plagues, and today is a major pest in Africa and the Middle East. The American Locust (*S. americana*) is a migratory species in our country.

Crickets
Family Gryllidae

True crickets are known to most of us only by their nightly song. The most common local species, a tree cricket, is seldom seen or found even when searched for because, like that of the ventriloquist, its voice is difficult to trace to its source.

Many folk beliefs exist about crickets. Their presence in the home is an omen of good fortune in many parts of the world. The House or Hearth Cricket (*Acheta domestica*) is fond of warmth and is thus frequently found near fireplaces in houses of Europe and eastern North America. Association of this cricket's cheerful singing with the most congenial place in the household no doubt accounts for our kindly attitude toward the "cricket on the hearth."

Crickets are kept in captivity and matched for combat in China. The sport has been as popular there as cockfighting is in other countries, and equally as extravagant wagers are made on the outcome of championship fights.

Like katydids, crickets "sing" by making frictional movements of roughened areas at the bases of the front wings. However, only the males possess the necessary structures. Their wings are sharply elevated above the abdomen when chirping.

It is common knowledge that the tempo of the song varies with surrounding temperature—increasing at higher degrees, decreasing at lower. This fact has inspired various formulae for calculating the temperature from the number of chirps per minute in different species. Our common tree cricket, (*Oecanthus* species), also called the "thermometer cricket," indicates the temperature in degrees Fahrenheit if one counts the number of chirps in 15 seconds and adds 40.

REFERENCE: Block, B. 1966. The relation of temperature to the chirp-rate of male Snowy Tree Crickets, *Oecanthus fultoni* (Orthoptera: Gryllidae). Entomol. Soc. Amer., Ann., vol. 59, pp. 56-59.

Crickets commonly found in the Los Angeles Basin are as follows:

Snowy Tree Cricket
(*Oecanthus* species)

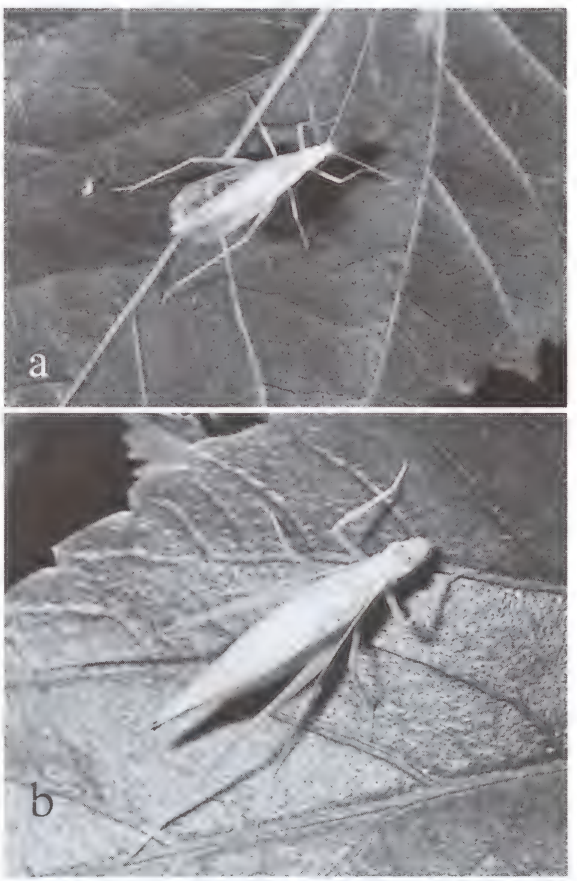


Figure 19. Snowy Tree Cricket: a.—male, b.—female.

This name actually refers to a complex of closely related species, which are distinguishable only by reference to minute anatomical details. They are all about ½ inch long and transparent greenish or white in color. The males are flattened with broad wings, the females cylindrical with the wings folded around the body. They live among the foliage of trees, shrubs and herbaceous vegetation with their familiar song punctuating the nights of summer and fall. The song consists of an incessant whistled "treet-treet-treet" (*niveus* group), or a

continuous trill (*californicus*).

The chirping is a prelude to courtship and mating, which are themselves involved processes. The sequence of behavior is described by Fulton as follows: "While the male is vigorously singing, the female lingers near and repeatedly nudges him, until finally the male ceases his song and holds his wings in a raised position; thereupon, the female promptly climbs on top of the male. In this position, she eats from the metanotal gland just behind the wings of the male (from whence an alluring substance is secreted). The insects are then in a situation proper for mating, which takes place with the female on top of the male."

Tree Crickets do eat plant matter but are generally considered beneficial because of their greater inclination to feed on plant pests such as aphids, scale insects, leaf hoppers, etc.

Tree Crickets, especially males, are occasionally attracted to lights.

REFERENCE: Walker, T. 1962. The taxonomy and calling songs of United States tree crickets (Orthoptera: Gryllidae: Oecanthinae). I. The genus *Neoxabea* and the Niveus and Varicornis groups of the genus *Oecanthus*. Entomol. Soc. Amer., Ann., vol. 55, pp. 303-322.

Field Cricket
(*Gryllus* species)

Figure 20. Field Cricket.

This species is not nearly as common in Los Angeles as the Tree Cricket. It is considerably larger (usually over an inch long) and largely black or brown in color (often only the wings are brown, the remainder of the body being black).

The Field Cricket lives in burrows in the ground, coming out sometimes in the day but more usually at night to feed on various herbaceous plants. In other areas of the southwest United States, it may swarm on warm nights around lights at gas stations and buildings and create a public nuisance. It also may constitute an agricultural pest when it invades garden and truck crops in large numbers.

The common song of this species is an intermittant, shrill "crrri-crrri-crrri." It also sings a "courtship song" consisting of an irregular series of short pulses of very high pitch.

Western Bush Cricket
(*Hoplosphyrum boreale*)

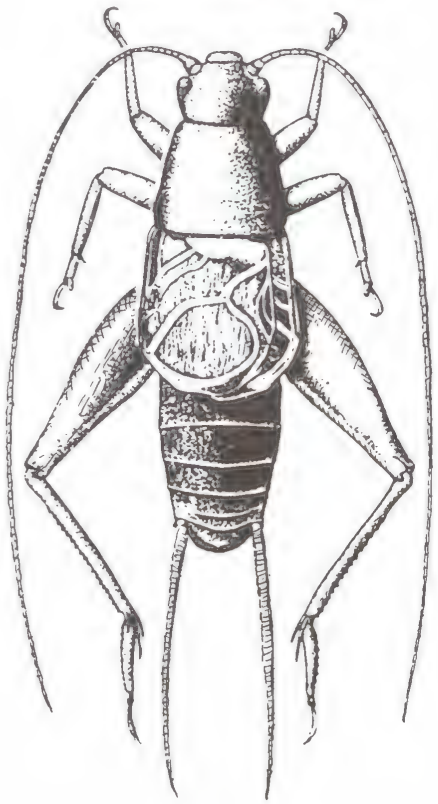


Figure 21. Western Bush Cricket, male. (From Rehn, J. and M. Hebard. 1912. Proc. Acad. Nat. Sci. Philadelphia, vol. 64, fig. 28.)

Another cricket which may be encountered rarely in the canyons and hills is this species. It is rather small (½ inch or slightly more in length), mottled brown with very short forewings (no hind wings) and covered with microscopic body scales. It lives under rocks and leaves or in tree crevices. The call is a high-pitched "cree-cree-cree."

Katydids
Family Tettigoniidae

Katydids are so named because of their supposed participation in a legendary love affair. Involved were two maidens, one of which was fair, the other (whose name was Kate) more on the stately side. The masculine corner of the triangle, an anonymous lad, fell in love with the fair one, scorning the passions of Kate. When he mysteriously died, the question was:"Did or didn't" the proud Kate do him in? The insect lives today as the deceased's spirit, continually proclaiming the answer each summer night. "Kate-she-did," or the variation "Katy-did."

Only the males of the common eastern *Pterophylla camellifolia* make this novel sound. In our two following local species (as well as others in their group—Phaneropterinae), both sexes can stridulate but each has its own song repertoire. The sound is produced by rubbing together roughened areas at the bases of the fore wings.

Like grasshoppers, katydids also have ears, but they are located on the front legs (near the base of the tibia in small depressions).

Katydids, or "long-horned grasshoppers," are easily distinguished from true grasshoppers by their much longer antennae (almost as long or longer than the body).

REFERENCE: Spooner, J. 1968. Pair-forming acoustic systems of Phaneropterine katydids (Orthoptera, Tettigoniidae). Anim. Behav., vol. 16, pp. 197-212.

Broad-winged Katydid
(*Microcentrum rhombifolium*)

Figure 22. Broad-winged Katydid, female.

This species usually reveals its presence only by its song, heard at dusk and evening in the late summer and fall (August to October). Males emit two distinct and inconsistently related sounds: lisps (in series of 2 or 3, separated by about 3 seconds) and series (15-35, at the rate of 8-9 per second) of ticks. The females respond to the ticks after about 0.16 seconds with a low intensity ticking which attracts the male to her. The function of the male lisp is not understood.

The adult insect is leafy green and difficult to see high in the foliage of broad-leafed trees and shrubs where it spends most of its time.

Eggs are lined up on twigs in a single or double overlapping file. The colorful nymphs are of interest for the gymnastics they perform. They do "push-ups" with the front four legs or sway from side to side in a manner suggestive of the movements made in some Oriental dance, wherein the body is maintained level and is moved laterally as the knees alternately bend and straighten.

Fork-tailed Bush Katydid
(*Scudderia furcata*)

Figure 23. Fork-tailed Bush Katydid, ovipositing female.

This species is common on all kinds of vegetation in the late summer and fall. It is easily distinguished from the Broad-winged Katydid by its more slender wings. Its song is also slightly different—males usually lisp ("Zeek") only (a few seconds apart in series of 3 or 4), although a shorter pulsed sound ("Zip") is also heard; ticking seems to be rare. Females respond after about 1.4 seconds with ticking, which attracts the male.

The females insert their eggs lengthwise in the edges of shrub and tree leaves.

Morse's Carinated Shield-back Katydid
(*Neduba morsei*)

Figure 24. Carinated Shield-backed Katydid (close relative of Morse's).

This katydid resembles a camel cricket (see below). On closer inspection it may be distinguished by the enlarged prothoracic shield which expands over the back of the remainder of the thorax and by dark triangular marks below the lateral ridges. Found also on vegetation, it may be heard emitting a series of "tsip-tsip-tsip" sounds, in diminishing intensity.

Ground and Camel Crickets
Family Gryllacrididae

Members of this group, sometimes called wingless long-horned grasshoppers, are brown or gray in color and lack wings and auditory organs. Many species possess strongly curved bodies, giving them a hump-backed appearance, hence the name "camel crickets."

Of the four species in our area, the first is by far the most common and best known:

Jerusalem Cricket
(*Stenopelmatus fuscus*)

Figure 25. Jerusalem Cricket.

This spectacular insect is also known by several other names, such as Sand Cricket, Child of the Earth (niña de la tierra), Chaco, and locally as Potato Bug. (Note that this is not the true Potato "Bug," which is a destructive striped beetle (*Leptinotarsa decimlineata*) of the eastern fields and gardens. The name, though erroneous, has caught on here for some unexplained reason). The Navajo Indians call it *woh-seh-tsinni,* meaning Old, Bald-Headed Man. Its large size (up to 2 inches long) and amber colored, almost human-like head have caused it to be the object of superstition to many southwestern and Mexican Indians. Although it can bite with considerable force, the Jerusalem Cricket is not poisonous.

These animals are nocturnal and live in the soil. They are seen only when they become stranded after a nightly sojourn or when uncovered by the gardener's spade. Food consists mainly of roots and tubers, although they may also eat dead animal matter.

Large size, bald head, winglessness and black bands on the fat abdomen are characteristic features easily identifying this insect.

In my position as entomologist at the Museum, I am asked by the curious public to identify this insect more than any other.

California Camel Cricket
(*Ceuthophilus californianus*)

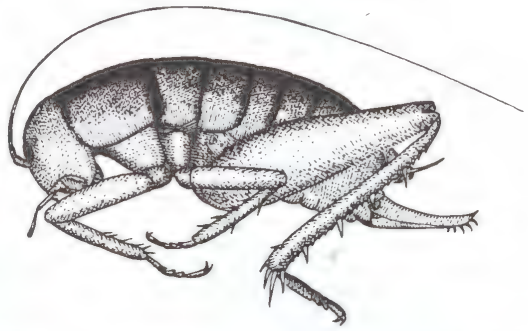


Figure 26. California Camel Cricket, female. (From Helfer, J. 1953. How to know the grasshoppers, cockroaches, and their allies, fig. 508)

This species is secretive and may only occasionally be seen at night on the ground or, more commonly, under stones, logs, boards etc. Rodent burrows may also serve as shelter. In these habitats it feeds on other living or dead insects.

The color is more or less uniformly pale yellowish to reddish-brown, often appearing banded transversely with a slightly darker shade. The hind legs of both sexes are very long with straight tibiae.

Southern California Mushroom Camel Cricket
(*Pristoceuthophilus marmoratus*)

Figure 27. Southern California Mushroom Camel Cricket, female.

Although very similar to the foregoing species, this camel cricket is generally smaller, mottled, and the male has bowed hind tibiae. The back of the abdomen also has numerous minute tubercles which may be seen with a strong magnifying glass. The back of the California Camel Cricket is smooth.

Little is known about its habits save that specimens are usually found under rocks, boards and similar cover on the ground in wooded or otherwise protected areas. It is common in foothill grassy areas under stones and rubble partly buried in the ground. The food probably consists of the many other small arthropods which also live in this same habitat.

Adults are seen in the winter months, young nymphs appearing in the spring. Older nymphs are found throughout the summer.

Southern California Chaparral Camel Cricket
(*Gammarotettix genitalis*)

Proportionately shorter hind legs (the tibiae of which are straight) and a blunt, rather than tapering abdomen distinguish this species from the two preceding. Also unlike the above and Camel crickets in general, it lives not on the ground but in brush and small trees, where it apparently feeds on the leaves.

Cockroaches
Suborder BLATTARIA

Cockroaches are much maligned insects. A few pesky species have given a bad name to the whole family of more than 50 North American and approximately 3,500 global species. These "bad" cockroaches are common household pests in most warmer parts of the world. By far the majority of kinds, however, are very interesting, so-called wild cockroaches which inhabit caves, burrow in sand dunes, live in ant nests, or exhibit other unusual life histories. Cockroaches are not all drably colored like the familiar household varieties either. Many tropical species sport yellow, red, green and other colors on their bodies and wings.

Our all-too-common household cockroaches are active primarily at night. During the day they hide in dark crevices: in or behind kitchen cabinets, drawers, stoves and refrigerators etc. The females lay their eggs in a hard, dark brown, purse-shaped capsule which may be carried about for several days, protruding from the end of her abdomen. It is dropped eventually, and later the young roaches hatch and scatter. Both young and adults are general feeders. Almost any crumb of food or other organic material left exposed around the house will serve them as a meal. For this reason, good housekeeping is the key to cockroach control.

The medical importance of cockroaches seems well demonstrated. Most of the domiciliary species have been incriminated, naturally or experimentally, in the transmission of some disease organisms, especially dysentery bacteria.

The kinds of cockroaches found in our area may be grouped into three categories on the basis of their place of origin:

I. Cosmopolitan, household species, long associated with man

American Cockroach
Oriental Cockroach
German Cockroach
Brown-banded Cockroach

II. Occasional imports (usually from the American tropics) which become temporarily or weakly established (often only in port areas)

Cuban Cockroach

III. Natives

Sand Roaches
Western Wood Roach
Field Cockroach

REFERENCE: Roth, L. and E. Willis. 1957. The medical and veterinary importance of cockroaches. Smithsonian Misc. Collections, vol. 134, pp. 1-147, pls. 1-7.

American Cockroach
(*Periplaneta americana*)

Figure 28. American Cockroach.

This is the species that Angelenos are referring to when they brag about the huge roaches in their basement. In spite of what anyone says, however, adult American Cockroaches rarely exceed two inches in length from the front of the head shield to the wing tips. (In Florida there is a much larger roach, known as the Death's Head Roach, *Blaberus craniifer,* which measures up to 3 inches.) The wings completely cover the abdomen of mature individuals of both sexes and are glossy reddish-brown. The head shield is paler reddish-brown with indistinct central markings. This is the most common local species, but it occurs only in small numbers.

Oriental Cockroach
(*Blatta orientalis*)

Figure 29. Oriental Cockroach: male (left), female (right), egg case (below).

Next in size to the preceding (about 1¼ inches long) is this shiny black to brownish species. The male has short wings (not quite reaching the middle of the abdomen); the female has almost no wings at all, existing only as small pads emerging from beneath the head shield. Because of the black color, the Oriental Cockroach is sometimes confused with large ground beetles and is so called. Another name used locally is "water bug," derived from its habit of living in wet areas—around toilet bowls, bath tubs, water pipes, etc.

The species has a long life cycle, up to two years. The egg cases of the female contain about 16 eggs.

The Oriental Cockroach is reported to be very common in the sewers of Los Angeles.

German Cockroach
(*Blatella germanica*)

Figure 30. German Cockroach: female with egg case (left), nymph (right).

This species is only about ½ inch long and light brown with two darker longitudinal stripes on the head shield. The wings extend beyond the tip of the abdomen in the adults of both sexes. A wary and active cockroach, it tends to reach higher population levels than the aforementioned species. Furthermore, it exhibits a degree of gregariousness,

so that tremendously dense infestations may develop. This is by far the most prolific roach of those mentioned here, having about 48 young per egg case. It can complete its life cycle in as little as 6 weeks.

The closely related Field Cockroach (*Blatella vaga*), distinguished by the contrasting dark pigment band between the eyes, is an outdoor desert species and may perhaps invade the eastern fringe of the Basin.

REFERENCE: Twomey, N. 1966. A review of the biology and control of the German Cockroach, *Blatella germanica* (L.), in California. Calif. Vector Views, vol. 13, pp. 27-37.

Brown-banded Cockroach
(*Supella supellectilium*)

Figure 31. Brown-banded Cockroach: nymph (left), female with egg case (right).

This cockroach, only about ⅜ inch long, is unusually marked with two pale bands crossing the fully developed pale brown wings. It is the least prevalent species and tends to be solitary in its habits. The females form cases with about 18 eggs.

Cuban Cockroach
(*Panchlora nivea*)

Figure 32. Cuban Cockroach. (From Roth, L. and E. Willis. 1960. Biotic Associations of Cockroaches, pl. 16)

Recognizable immediately by its pale translucent green color, this roach is not permanently established in the Basin but comes in occasionally on bunches of bananas or other produce shipped from Central America. It will be found mostly around the harbor area but may spread inland at times. The species does not seem to be as common now as in the past, probably because of the recently adopted practice of packaging bananas in cardboard cartons. It is about one inch long.

REFERENCE: Roth, L. and E. Willis. 1958. The biology of *Panchlora nivea* with observations on the eggs of other Blattaria. Amer. Entomol. Soc., Trans., vol. 83, pp. 195-207.

Sand Roaches
(*Arenivaga* species)

Figure 33. Sand Roach: male (left), female (right).

The males and females of these roaches look vastly different: males have the normal cockroach form with fully developed, mottled pale-brown wings, but the females are oval, wingless creatures looking something like trilobites, the extinct aquatic arthropods of Palaeozoic times.

These roaches are common about sand dunes near the coast or inland in our neighboring deserts and foothills. Their presence is indicated by the small serpentine ridges of their burrows, which are formed near the surface like miniature mole runs. These ridges are most evident at night when the roaches are active and when the light of a lantern casts strong shadows over the sand surface. Males often are attracted to light.

Western Wood Roach
(*Parcoblatta americana*)

Figure 34. Western Wood Cockroach.

The males of this species are glossy brown and fully winged. The females resemble small Oriental Cockroaches, with only small wing pads. They are common locally under rocks on grassy slopes. The males often are attracted to light.

Praying Mantids
Suborder MANTODEA

Most of the attention paid these curious insects centers around their feeding habits. Exclusively carnivorous, they catch small animal prey with quick thrusts of their front legs, which are structurally modified for grasping.

The mantid does not actively seek its food but usually waits for it, motionless for long periods at a time, with the head upraised and the forelegs together in front, as the hands are held in prayer. This attitude justifiably led to the common name, although "preying" mantid is probably "more realistic," because, to quote Gurney, "the only thing mantids would seem to pray for is a square meal."

Because they feed voraciously on flies, grasshoppers, caterpillars and other insects, many of which are garden and crop pests, mantids should be considered beneficial. Curiously, however, many people are afraid of them and even hold superstitions stemming from the creature's pugnacious temperament and humanoid actions. In respect to the latter, one should mention the mantid's relatively narrow neck which, like the owl's, allows the head to be rotated freely through a nearly 360° arc. One gains the impression of being "stared at" when the insect follows one's movements with its head and eyes.

These peculiarities have been the basis for a variety of names: "nuns," "saints," "preachers," "rear horses," "devil horses," etc. The word mantid (*mantikos*) itself means "prophet" in Greek.

Mantid females enclose their eggs in a frothy mass which hardens and forms a protective capsule.

Local residents rarely see mantids although they are reasonably common. Their occurrence is limited to shrubby vegetation on what few relatively undisturbed hilly areas are left. In the fall, males may occasionally be seen flying or near lights.

REFERENCE: Gurney, A. 1951. Praying mantids of the United States, native and introduced. Pages 339-362 *in* Annual Report Smithsonian Institution for 1950.

The following three species are well established in the Basin although two or three exotic mantids (Carolina Mantid, Chinese Mantid, European Mantid) occasionally show up as escapees from imported egg masses. The latter can be purchased from eastern dealers.

California Mantid
(*Stagmomantis californica*)

Figure 35. California Mantid: a.—adult male, b.—egg mass.

This species is moderately large (2-2½ inches long) and mottled brown or greenish in color. The males have fully developed wings which, when folded, extend beyond the tip of the abdomen; the female's wings are very short and reach only to about the middle of the abdomen. It prefers an arboreal habitat mostly being found on shrubs of the Coastal Sage plant community.

Minor Ground Mantid
(*Litaneutria minor*)

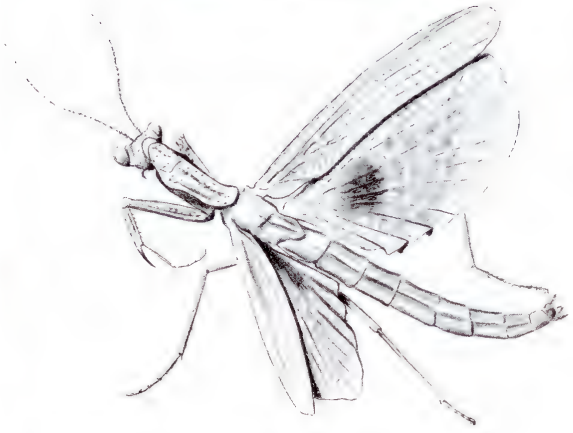


Figure 36. Minor Ground Mantid.

This is a small (about 1¼ inches long), slender, pale tan or greyish mantid. The male often has a dark spot near the base of the fully developed wings; the female has practically no wings, only short stubs. It is a very active species usually not found on vegetation, preferring to run on the ground among rocks and short grass in search of prey.

As with other mantids, there is one generation per year. Eggs are laid in the fall, they hatch the following spring and the nymphs grow during the summer to mature as adults in the fall.

REFERENCE: Roberts, R. 1937. Biology of the minor mantid, *Litaneutria minor* Scudder (Orthoptera, Mantidae). Entomol. Soc. Amer., Ann., vol. 30, pp. 111-121.

Mediterranean Mantid
(*Iris oratoria*)

Figure 37. Mediterranean Mantid: female depositing egg case.

Found commonly in the San Joaquin, Coachella and Imperial Valleys, this species has made its way into the Basin and appears to be establishing itself here. The species is native to the Mediterranean region but somehow was introduced into the United States, probably in the '30s or '40s.

This mantid is similar to the California Mantid, with which it might be confused, being about the same size (2 inches long) and coloration (although the brown form is not known). It is most easily distinguished by the color pattern of the hind wing which has a shining bluish-black blotch near the base and an area of dull brick red toward the front. The hind wing of the California Mantid is generally brown.

REFERENCE: Gurney, A. 1955. Further notes on *Iris oratoria* in California. Pan-Pacific Entomol., vol. 31, pp. 67-72.

Keeping mantids in captivity

Many people like to keep adult mantids alive as pets. They are easily maintained in a glass jar. A small potted house plant placed in an aquarium or large screen cage makes an even better home.

Since mantids are carnivorous, they must be kept supplied with fresh animal food. House flies, grasshoppers, moths and other garden insects may be introduced alive into the cage. Small pieces of uncooked meat or dead insects held with forceps may be fed to the mantid by hand, but immobile bodies of insects or meat are usually not picked up from the cage floor.

One may acquire mantids by searching for them as adults or by rearing them from purchased egg capsules. The latter are available from biological supply dealers in the fall and winter. Nymphs often hatch unpredictably in southern California; merely bringing them indoors or into our warm winter climate may cause the eggs to hatch almost immediately.

The young are cannibalistic, so they should be kept in individual containers. They may be fed fruit flies, aphids or other small insects until they are larger.

Walkingsticks

Suborder PHASMIDA

Like mantids, walkingsticks are seldom seen in the Los Angeles Basin, but this is due probably more to their cryptic form than to their rarity. They are virtually impossible to distinguish from the twigs of the shrubby plants where they live and which they mimic perfectly. Cautious behavior adds further to the camouflage effect.

Unlike mantids, walkingsticks are herbivorous, feeding on various species of native vegetation. Their taste is fairly specific so it is nearly impossible to keep caged specimens without fresh leaves of their proper host plant.

We have only three main types locally. All are wingless and more or less stick-like in form. These are by no means typical of their family. Many of the hundreds of tropical species have fully developed wings and/or leaf-like form.

Gray Walkingstick
(*Pseudosermyle straminea*)

Figure 38. Gray Walkingstick.

Its long antennae (longer than the fore femur) and the roughened, ridged or spined thorax distinguish this from the preceding species. It is generally light gray or whitish in color, with a body

1½ to 3 inches long. A desert species, occurring on tall grasses such as Rabbitbrush (*Chrysothamnus nauseosus*), Burro-bush (*Franseria dumosa*), Sagebrush (*Artemisia*) and other desert shrubs, it enters our area only in the drier eastern portions.

Western Short-horned Walkingstick
(*Parabacillus hesperus*)

Figure 39. Western Short-horned Walkingstick.

This is the species most likely to be encountered in the Basin. It is readily recognized by its short antennae (much shorter than the femur of the front leg). It is light to dark brown, and the body is 2½ to 3½ inches long. One should look for it on tall grasses and native herbaceous plants in hilly areas.

Timemas
(*Timema* species)

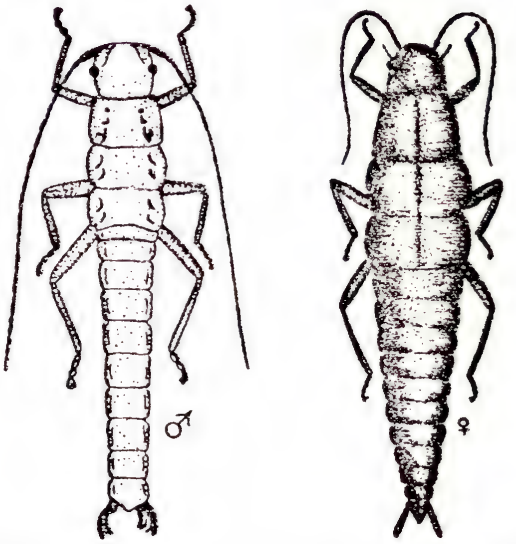


Figure 40. Timemas: male (left), female (right). (From Helfer, J. 1953. How to know the grasshoppers, cockroaches, and their allies, fig. 25.)

Timemas are not typical walkingsticks. They are only ½ to 1 inch long, considerably shorter and stouter than the above species. Though usually mottled green in color, brown or pinkish individuals frequently occur.

Probably three species live in our surrounding mountains, especially the Santa Monicas and San Gabriels, on chaparral shrubs and oaks. They may be common in the spring on Scrub Oak (*Quercus dumosa*) and Wild Lilac (*Ceanothus*).

REFERENCE: Gustafson, J. 1966. Biological observations on *Timema californica* (Phasmoidea: Phasmidae). Entomol. Soc. Amer., Ann., vol. 59, pp. 59-61.

Termites

Order ISOPTERA

Of all the insects which live around us in the city, termites probably cause the most concern. The home owner desiring to sell his house is made painfully aware of their existence when he is told by an inspector that he has an infestation which must be corrected before he can transfer ownership. Most loan companies make termite inspection one of the requisites of a clear title.

Like cockroaches, not all termites are despicable. Most of the many hundreds of world species actually benefit man be cleaning up cellulose debris from the earth's surface. Symbiotic micro-organisms in the intestine of the worker caste enable the termite to obtain nutrition from this otherwise indigestable material. When it reaches the intestine the wood swallowed by the termite is broken down into simple, digestible sugars. "Defaunated" termites (with their microorganisms killed by special treatment) die of starvation even though they may still ingest wood.

Termites are social insects. The colony is founded by a mated ("royal") pair of winged adults. Swarms of these reproductive forms are often seen issuing from frame houses or other wooden structures on warm days following a rain.

Soon after hatching, the nymphs of the first brood are able to take care of themselves and the royal pair, freeing the latter of all tasks save the essential one of producing new offspring. Subsequently the colony grows in size and complexity, and different forms develop, each with a specialized anatomy and particular job to do in the colony, which now is really a large, diversified family. The different types are called "castes" and typically consist of (1) the queen—original female member of the royal pair, (2) king—original male member of the royal pair, (3) workers—sexually undeveloped females which tend and feed the royal pair in addition to building and maintaining the nest, (4) soldiers—modified workers with a massive head and enlarged mandibles employed in fighting off intruders to the colony.

The mature colony periodically produces generations of adult broods. These forms are winged and sometimes confused with carpenter ants when issuing from wood during nuptial flights. They are readily distinguished, however, by the four similarly shaped wings (hind wing much smaller than the fore in ants) and lack of the narrowed waist region characteristics of ants.

Contrary to popular belief, redwood, cedar and eucalyptus are not totally immune to termite attack. Though resistant, due to the presence of oils which naturally repel termites, these woods become susceptible after moisture and age have modified their original composition.

REFERENCES: Ebeling, W. and R. Pence. 1965. Termite Control. Calif. Agr. Exper. Sta. Extension Service, Circ. 469 (Revised). Univ. Calif. Press, Berkeley.
Krishna, K. and F. Weesner, Eds. 1969-70. Biology of Termites. Academic Press, N.Y. 2 vols.

The following three termite species are prevalent in our area:

Family Termitidae

Western Subterranean Termite
(*Reticulitermes hesperus*)

Figure 41. Western Subterranean Termite: queen (center), soldiers (lower left and right), and soldiers.

On warm sunny days following the first autumn rains, swarms of the winged adult forms of this termite are commonly noticed issuing from frame houses, fenceposts and other wooden structures in contact with the ground. The species has a high humidity requirement which forces it to maintain contact with the ground. It may infest wood up to 3-5 feet above ground, traveling up and down between the wood and the subterranean galleries through protected available crevices in mortar, concrete foundations and the like, or through earthen tubes constructed from chewed bits of soil, wood and saliva.

Here, and in much of the West, this is the species that causes the greatest damage. It is probably safe to say that the majority of older houses in the Los Angeles area are infested to some degree with this termite. In general, however, noticeable damage does not appear unless tunneling activity has proceeded to the point of weakening structural members or stress areas such as flooring and stairways. (Unlike the following, this species forms no pellet piles.) The workers attack wood only in the soft spring growth region of the annual rings. Thus a cross section of an infested timber shows a characteristically radial tunnel pattern. Furthermore, severe effects require a period of years to develop—our termites do not reduce a house to a pile of sawdust overnight! Homeowners are urged to have periodic inspections to determine the presence of termites. This is simply good insurance and should be done regardless of how many preventative

methods were employed in the original construction.

Family Kalotermitidae

Western Drywood Termite
(*Incisitermes minor*)

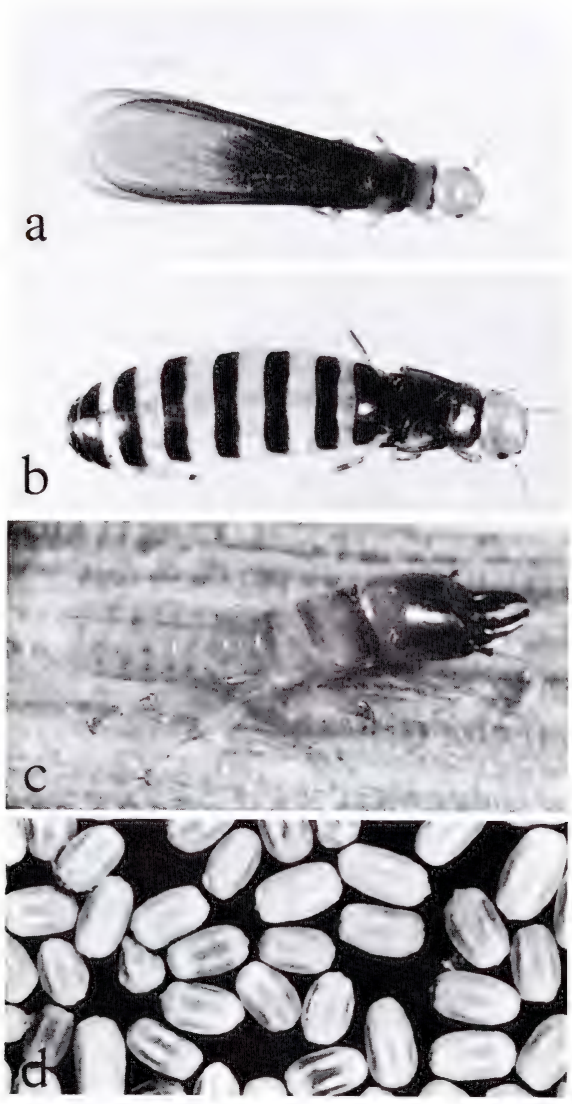


Figure 42. Western Drywood Termite: a.—winged adult, b.—queen, c.—soldier, d.—pellets.

Though about as common in buildings locally as the preceding, this species ordinarily causes less serious damage. It looks like the Subterranean Termite but is a little larger and the head of the sexual forms is reddish rather than black. The tunneling action in wood is also distinctive: the workers burrow across the wood grain as well as with the grain, excavating large pockets in all directions.

Drywood termites can become established anywhere, being especially common in attics; they require no connection with the ground. Their presence is often indicated by "saw dust" piles of fecal pellets. This material can be definitely identified of termite origin, rather than from other wood boring insects, by the roughly hexagonal cross-section of the individual pellets.

Colonies contain the usual castes except true workers. The nymphs perform the worker function until matured into reproductives or soldiers.

Family Hodotermitidae

Pacific Dampwood Termite
(*Zootermopsis angusticollis*)

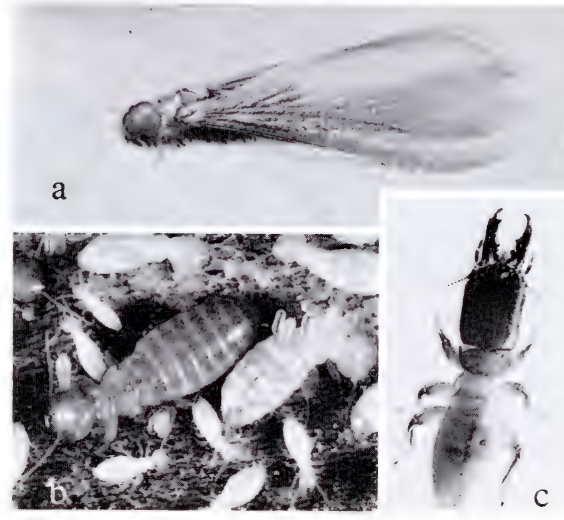


Figure 43. Pacific Dampwood Termite: a.—winged adult, b.—queen and workers, c.—soldier.

This is a much larger species than either of the foregoing. The nymphs are about ½ inch, the soldiers ¾ inch, long. All types of wood are attacked, that which is buried in the ground and subject to moisture and decay being most vulnerable. Although of relatively occasional occurrence in the Basin, it is extremely common in the San Gabriel Mountains in conifer logs and stumps. Late afternoon or early evening swarming may take place throughout the year. Typically, however, July to October is the swarming season. The winged forms are strong fliers and are attracted to lights at night. There are only two well defined castes, the soldier and reproductive; the true worker is absent, its place being taken by nymphs as in the Western Drywood Termite.

Psocids

Order CORRODENTIA

In spite of the fact that many species of psocids (pronounced "só-sids") live in our area, they are seldom noticed because of their small size and secretive habits. Most are found on foliage or tree bark and have been given the name "bark lice." Though the wingless forms are slightly louse-like in appearance, they are nonparasitic insects, feeding principally on various organic materials of vegetable origin (pollen, mold spores, etc.).

A few species are domiciliary; the following local species is most likely to be noticed by the homeowner during spring housecleaning:

Family Liposcelidae

Book Louse
(*Liposcelis divinatorius*)

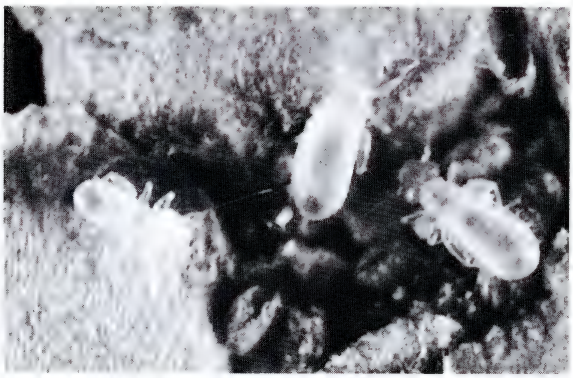


Figure 44. Book Louse.

This wingless species is called the Book Louse because it is so commonly found scurrying over windowsills, books, and papers, especially those stored in damp cellars and garages. It is minute (less than 1/32 inch in length) and light brown in color.

Although its feeding may do minor damage to book bindings, the presence of this species is usually no more than an annoyance.

True Lice

Orders ANOPLURA and MALLOPHAGA

True Lice belong to two orders, the sucking lice (Anoplura) and the biting lice (Mallophaga). The groups are also called, respectively, Mammal Lice and Bird Lice because of their usual hosts. The dichotomy is not without exception, however, as some bird lice are found on mammals. The principal distinction, as the former names imply, is in the type of mouthparts and feeding employed. Sucking Lice use a set of long, hypodermic-like stylets to pierce the skin and withdraw the blood of mammals; Biting Lice typically gnaw on fragments of feathers, hair and skin with a simple pair of mandibles.

All true lice are wingless ectoparasites. That is, they live closely attached to their warm-blooded hosts and cannot pursue a free life as most other insects. As is the case with parasites in general, they show many interesting structural modifications, for their way of life is demanding and their environment unusual. Of special note in this respect are the clawlike legs which enable them to cling tenaciously to feathers and hairs in spite of the host's preening and scratching.

Many species transmit diseases or harm their hosts in other ways. Around the world there are about 2,600 species of Biting Lice and 250 species of Sucking Lice.

The following species in our area are worthy of remark:

Family Pediculidae

Human Louse
(*Pediculus humanus*)

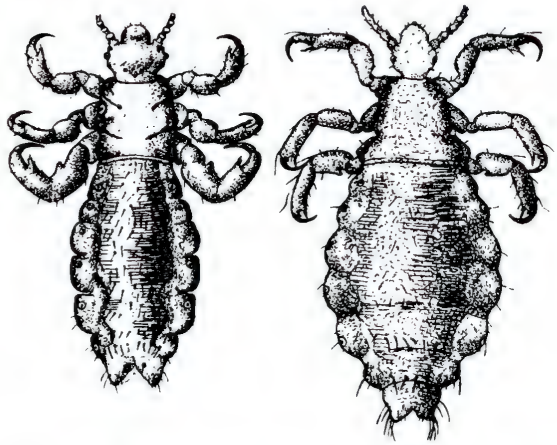


Figure 45. Human Louse: head infesting form (left), body infesting form (right). (From Patton, W. and F. Cragg. 1913. Textbook of medical entomology)

Like the Bedbug, this menace is not as prevalent today as in the past because of improved public and personal hygiene. Yet it still pops up here and there from contaminated sources and remains the lone true companion of the hobo.

A sucking louse, it is found only on man, to

whom it causes much discomfort in exchange for a blood meal. Two forms are known, one infesting the hair of the scalp (head louse); the other living in clothing near the body surface (body louse).

Bites of the Human Louse cause a slight local reaction accompanied by itching. Prolonged infestation may result in a general thickening and pigmentation of the skin ("Vagabond's Disease").

The direct effects of the louse's bite are minor compared to the misery it is capable of causing by transmitting Epidemic Typhus, a very serious disease produced by infection with the rickettsial micro-organism, *Rickettsia prowazeki*. Fortunately, the disease is not of local concern; but as a devastator of populations it has had few rivals in Europe where it has actually turned the tide of history.

In the vernacular, the Human Louse is known as the "cootie." Its eggs, which are firmly attached to head and body hairs, are called nits.

REFERENCES: Buxton, P. 1947. The louse. Edward Arnold and Co., London.
Zinsser, H. 1935. Rats, lice and history. Little, Brown and Co., Boston.

Crab Louse
(*Phthirus pubis*)

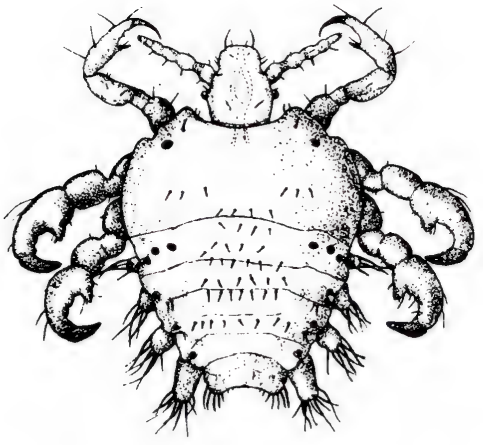


Figure 46. Crab louse. (From Patton, W. and F. Cragg. 1913. Textbook of medical entomology)

The Crab Louse ("crabs") is so named because of its broad, flat body and crab-claw legs. It has sucking mouthparts and normally infests the hairs of the pubic region, though at times it is found in other hairy regions of the body. The most common form of transference is through sexual intercourse, although it may be picked up from infested bed linen, clothing and other sources.

Although responsible for local irritation and itching, this louse is not a vector of any human disease.

REFERENCES: Nuttall, G. 1918. The biology of *Phthirius pubis*. Parasitology, vol. 10, pp. 383-405.
Keh, B. and J. Poorbaugh. 1971. Understanding and treating infestations of lice on humans. Calif. Vector Views, vol. 18, pp. 24-31.

Family Philopteridae

Slender Pigeon Louse
(*Columbicola columbae*)

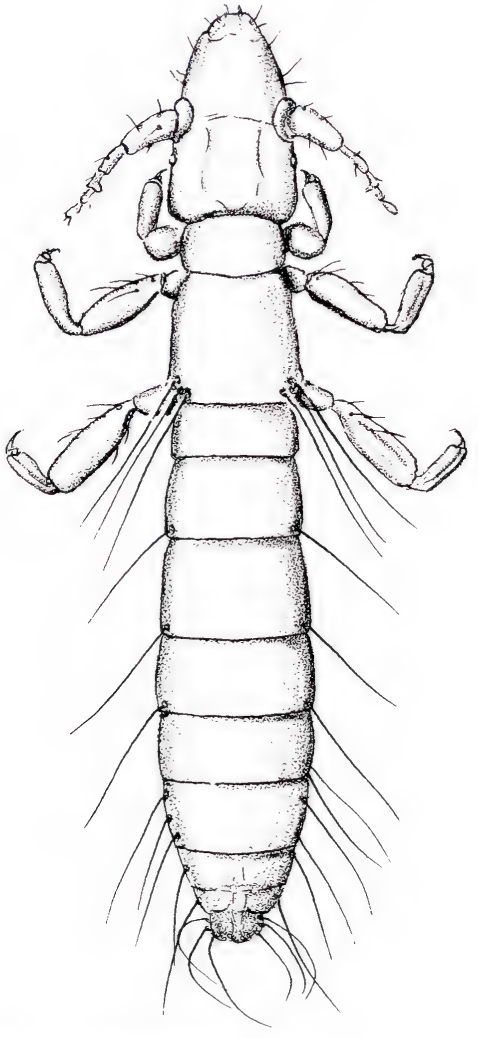


Figure 47. Slender pigeon louse.

This biting louse is characterized by its very elongate shape. It is very abundant on domestic pigeons, especially those making up the feral flocks

around the center of Los Angeles. It feeds on the barbules of the feathers. The eggs are laid in groups on the underside of the pigeon's wing, principally on the long flight feathers. Infestations apparently do little harm, if any, to the bird.

REFERENCE: Martin, M. 1934. Life history and habits of the pigeon louse. Canadian Entomol., vol. 66, pp. 6-16.

Family Menoponidae

Chicken Body Louse
(*Menacanthus stramineus*)

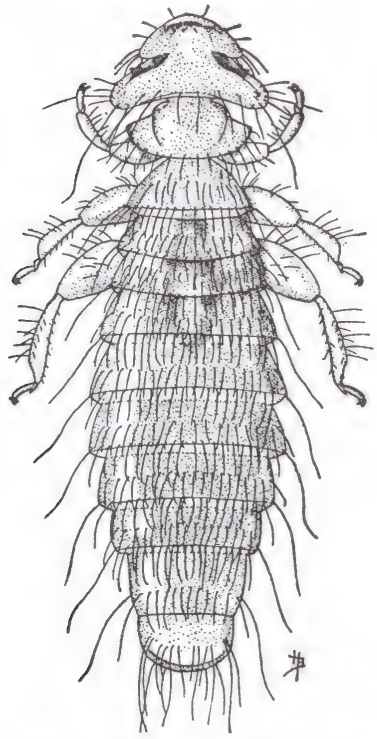


Figure 48. Chicken body louse. (From Bishopp, F. and H. Wood. 1921. U.S. Dept. Agr., Farmer's Bull. 801, fig. 10)

Another biting species, this louse lives directly on the skin of chickens and turkeys, most abundantly about the vent and under the wings. It also occurs on guinea fowl, peafowl and game birds raised with chickens.

Heavy infestations seriously affect the vigor of poultry, due to the irritation caused by constant action of the mouthparts and sharp claws on the lice's feet.

The eggs are fastened to the basal barbs on the feather shafts, especially those below the vent.

True Bugs

Order HEMIPTERA

The True Bugs form a diverse assemblage characterized by few consistent features except the universal possession of sucking mouthparts. These structures form a beak which contains piercing stylets and acts like a hypodermic syringe to pierce plant tissues (or animal tissues in some cases) and withdraw vital fluids, weakening the host or transmitting disease. Because of this habit many species have become agricultural or medical pests.

These are the only insects which, according to the philologist, rightfully deserve to be called "bugs." The word comes from the Old English word *bwg* meaning hobgoblin or apparition.

Stink Bugs

Family Pentatomidae

The bugs in this family are the real "stinkers" of the insect world. Odoriferous glands opening near the coxae of the hind legs produce a strong, acrid smelling vapor which serves to discourage enemies. Several species and genera are found locally; those most likely to be recognized are the following:

Uhler's and **Say's Stink Bugs**
(*Petidia uhleri* and *P. sayi*)

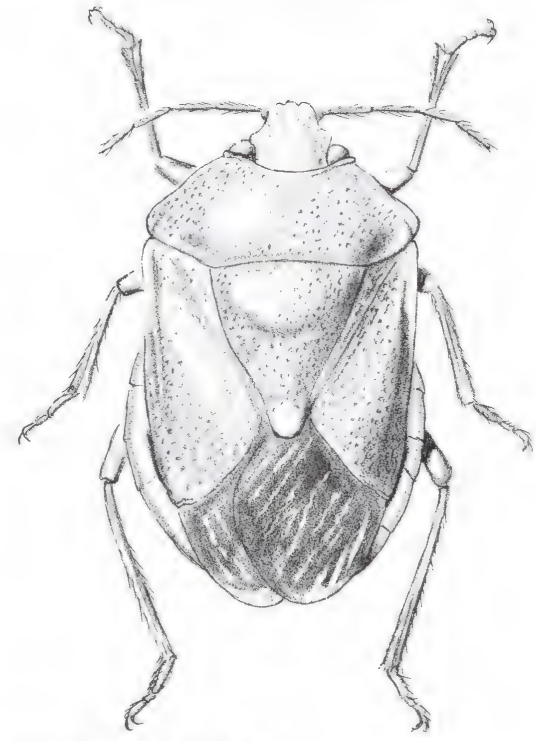


Figure 49. Say's Stink Bug.

These are two closely related species. Both are bright green, about ½ inch long, and with light spots on the scutellum (triangular area in the middle of the back). On the first (the more slender) species these spots are pale and indistinct; on the second, they are more distinct and the spot at the tip of the scutellum is orange, like either edge of the body. Say's species also has yellow mottling on the wings while Uhler's is solid green. Both species are common in the summer on weedy vegetation in vacant lots and on some garden plants.

Harlequin Bug
(*Murgantia histrionica*)

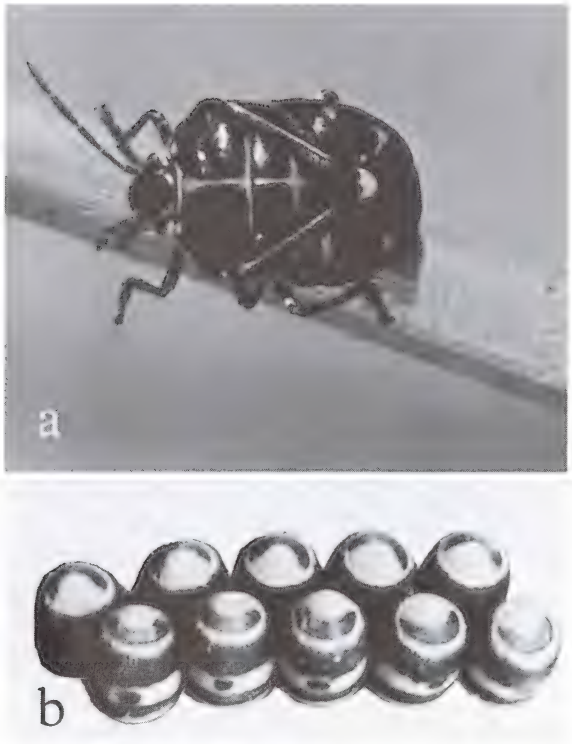


Figure 50. Harlequin Bug: a.–adult, b.–eggs.

The common name of this stink bug (also called "Calico Back") is derived from its variegated color pattern. Basically black, it sports bright red and yellow spots on its back, including a "+" on the scutellum. The white eggs are also colorfully marked with black rings and a spot so that they look like miniature barrels, the rings emulating hoops, the spot marking the bunghole. The coloration of the gregarious nymphs also is characteristic.

The Harlequin Bug is usually seen in the garden on cabbage and related plants, or in vacant lots and hillsides on wild mustard.

Squash Bugs

Family Coreidae

The two species following belong to the family Coreidae, the squash bugs, whose members are often called "stink bugs" because they emit a repugnant odor like the true stink bugs (family Pentatomidae). This common name should be reserved for the latter family, however.

Squash Bug
(*Anasa tristis*)

Figure 51. Squash Bug.

The Squash Bug may be found in vegetable gardens and where field crops are still grown. It feeds on the sap of a variety of cucurbit (squash family) and viney plants, especially squashes and pumpkins.

Adults overwinter, to mate and begin laying eggs in the spring. Nymphs and newly matured adults may be evident all summer. They are "grainy," or speckled dark grayish-brown and are approximately ⅝-¾ inch long. The lateral margins of the abdomen which protrude beyond the folded wings are orange and brown.

Western Leaf-footed Plant Bug
(*Leptoglossus clypeatus*)

Figure 52. Western Leaf-footed Plant Bug.

This bug takes its name from the leaf-like enlargements of the hind tibiae. The body is generally brown with varied yellow markings, the most characteristic being an irregular, narrow transverse band across the middle of the wings.

This species is also known in the west as the Chincha, a word in Spanish meaning "bug." It is usually found on junipers in the more arid eastern portions of the Basin.

Seed Bugs

Family Lygaeidae

Common Milkweed Bug
(*Lygaeus kalmii*)

Figure 53. Common Milkweed Bug.

This is a pretty bug, approximately ⅜ inch long with white and red spots on its back. The two white spots in the middle of the terminal membranous region of the wing are characteristic. Occasionally it is seen around the home garden where it has strayed from nearby milkweed. As this plant seems to be declining locally in the face of human progress, the insect will no doubt become increasingly rare.

Scentless Plant Bugs

Family Corizidae

Western Box-elder Bug
(*Leptocoris rubrolineatus*)

Figure 54. Western Box-elder Bug.

This species is superficially similar to the preceding, being about the same size (½ inch long) and likewise gayly marked. The distinguishing features are the bright red abdomen and three red lines running lengthwise on the pronotum and reddish margins to the wings.

The bug feeds primarily on box-elder, ash, and maple, and usually is found only where these trees grow, especially in the canyons of the mountains surrounding the Basin. Adults are frequently seen in these canyons on warm spring days, swarming

in the air and crawling over vegetation in large numbers. The species overwinters in the adult stage, hiding in dry sheltered places. When they roam indoors in large numbers, these bugs often alarm housewives.

The insect nearly always remains only on female or seed-bearing trees, seeming to avoid male or staminate trees.

REFERENCE: Wollerman, E. 1966. The boxelder bug. Pest Control Operator's News, vol. 26, pp. 18-20.

Largid Bugs

Family Largidae

Bordered Plant Bug
(*Largus cinctus californicus*)

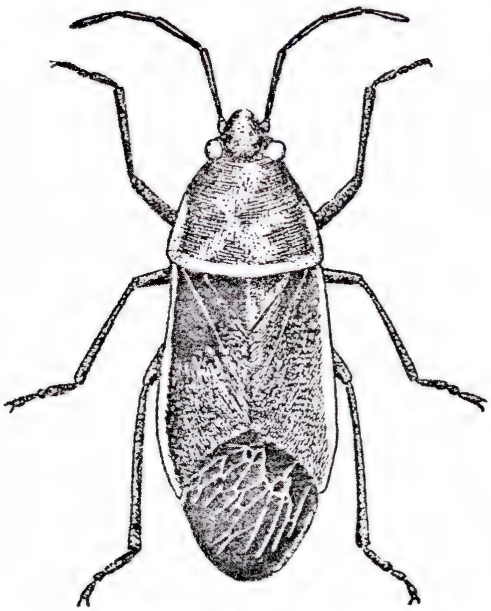


Figure 55. Bordered Plant Bug. (From Essig, E. 1929. Insects of Western North America, fig. 231)

This is a conspicuous bug at times because of its habit of congregating in very large numbers on certain plants, especially herbaceous weedy shrubs. It is found like this only sporadically in the Los Angeles Basin proper, but is quite frequently noted in the nearby desert areas.

It is about ½ inch long as an adult, and its most characteristic markings consist of orange margins and fine orange speckles on the basal portions of the wings.

Assassin Bugs

Family Reduviidae

Western Cone-nose Bug
(*Triatoma protracta*)

Figure 56. Western Cone-nose Bug.

This bug has a bad reputation, rightfully earned. It belongs to a group of bugs called kissing bugs (from their habit of biting sleeping persons about the lips), whose normal food is the blood of vertebrate animals, including man. In the tropics there are many species, some of which act as vectors of a serious disease called Chagas' Disease (the pathogen of which is a trypanosome protozoon similar to that which causes African Sleeping Sickness). Chagas' Disease does not appear here, even though the Western Cone-nose Bug often harbors a trypanosome parasite apparently identical to the one involved in the disease. It may be a non-virulent strain.

The bug is nonetheless a medical problem in Los Angeles because of its venomous bite. Foreign substances in the bug's saliva are capable of causing a serious allergic reaction in sensitive persons. The symptoms range from simple itching, nausea, chills, and dizziness, to anaphylactic shock.

Our species of kissing bug normally lives in the dens of wood rats (*Neotoma*), where it feeds on the blood of this rodent. Only occasionally do man and the bug come in contact. This usually occurs when housing developments invade formerly uninhabited areas, especially brush-covered hillsides and canyons, where the wood rats and their bug parasites have long been living in natural balance. The bugs now have a new source of blood which they find after accidentally entering homes through cracks, vents, open doors, etc. They are attracted to lights and often enter patios or houses in this

manner. They do not occur in the heavily urbanized parts of the city.

Persons exhibiting severe allergic symptoms after a known bite by one of these bugs should consult a physician immediately. The bug should also be captured and kept alive for diagnosis. It should be emphasized that the bug's bite causes little or no reaction in most individuals, and like the sting of the honey bee is not to be unduly feared except by a few especially sensitive individuals.

Some of the other names by which kissing bugs are known are Bellows Bug, Walpai Tiger (Arizona), Cross Bug, Big Bedbug, China Bedbug, Sacred Bug, etc.

The Western Cone-nose Bug can be readily recognized by the photograph. It is about 5/8 to 3/4 inch long and is nearly all black or dark brown in color.

REFERENCE: Wood, S. and F. Wood. 1964. Nocturnal aggregation and invasion of homes in southern California by insect vectors of Chagas' Disease. J. Econ. Entomol., vol. 57, pp. 775-776.

Western Corsair
(*Rasahus thoracicus*)

Figure 57. Western Corsair.

This bug, like the preceding, has a fearsome bite. It sucks the blood of other insects, however, and bites man not for food but only in self-defense.

About 3/4 inch long, it is uniformly amber in color with black wings. A conspicuous circular amber spot marks the middle of the center of the wing membrane.

The species is scarce in the Basin.

Bedbugs

Family Cimicidae

Common Bedbug
(*Cimex lectularius*)

Figure 58. Common Bedbug.

Fortunately bedbugs are not as common locally as they are in other parts of the country. Our climate is probably a bit too dry for them. Nevertheless, they persist in some places, especially unkempt cheap hotels, motels, rooming houses, and residences. The species may be recognized by its small size (about 3/16 inch long), dusky red color (changing to bright red when the bug is ingesting blood) and flatness. It is entirely wingless, even as an adult.

It feeds exclusively on human blood indoors,

invading the bed at night for its meals. Although the bite may cause immediate pain in some individuals, the first indication of its presence often may be only dark stains (from the bug's excrement) on bed sheets or itching bites the next day. Heavy infestations of bedbugs also are accompanied by a characteristic, disagreeable musky odor coming from scent glands similar to those possessed by stink bugs.

There are many mistaken ideas about the sources of infestations, some of which probably stem from the bug's ability to withstand long periods without food. Infestation always begins, of course, by introduction from other pre-existing infestations. Transportation easily occurs on clothing, bedding, or overstuffed furniture. During the day bedbugs hide in crevices behind wall decorations and in furniture.

Although its primary host is man, it also occurs on a wide variety of other mammals and birds, especially chickens and bats. The Common Bedbug is not known to be a primary vector of any human disease, in spite of its indiscriminate blood-sucking habits.

REFERENCE: Johnson, C. 1952. The Bed Bug. New Biol., vol. 13, pp. 80-97.

Aquatic and Semi-aquatic Hemiptera — "Water Bugs"

There are several kinds of Hemiptera found locally which are often noticed by fishermen, hikers, owners of fish ponds or swimming pools, and other persons who have investigated the few standing or moving bodies of water in the Los Angeles Basin. These bugs are of two categories: truly aquatic—living beneath the surface for an extended period of time, or semi-aquatic—being found on the surface or only near the water. Common examples of the first group are the following:

Aquatic

Giant Water Bugs

Family Belostomatidae

Giant Water Bug
(*Abedus indentatus*)

Figure 59. Giant Water Bug.

This is a fairly large (1¼ inch long), completely aquatic bug. It is found in running water in small streams where it clings motionless to underwater objects, moving only to catch and feed on other aquatic insects, tadpoles, and small fish, or to come to the surface to replenish the air supply which it carries in a cavity beneath its wings. In the winter, male specimens are frequently found with masses of large pale brown eggs attached to their backs. This seems to be the preferred place of egg deposition by the females.

The generic name *Abedus* means "an eater," and refers to the voracious appetite of these bugs. The etymology of the name "toe biter," which is another common name given these bugs by swimmers, needs no explanation.

Backswimmers

Family Notonectidae

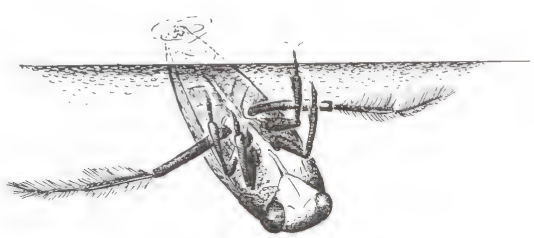


Figure 60. A backswimmer *(Notonecta).*

These bugs are easily recognized in their still-water habitat for they swim upside down, the hind legs moving to and fro like oars. In common with the Giant Water Bug, Backswimmers are predators, and their piercing mouthparts can inflict a painful wound to the finger of a careless handler. These bugs usually place their eggs on or in the leaves and stems of aquatic plants.

Four species are found in the Basin in stream pools and ponds. They are, in order of abundance, *Notonecta kirbyi, N. unifasciata, N. hoffmanni, Buenoa scimitra,* and *B. omani.*

Members of the genus *Notonecta* are larger (½ - ⅝ inch) and multicolored; those of *Buenoa* are smaller (⅜ inch) and pale translucent in appearance.

Water Boatmen
Family Corixidae

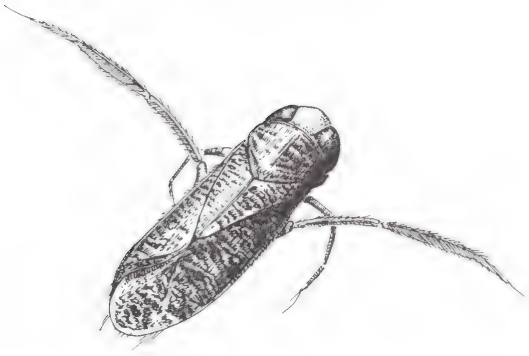


Figure 61. A water boatman.

Water boatmen resemble backswimmers generally but they swim in normal fashion, right-side-up and are much flatter. Unlike the foregoing species, they are herbivorous, feeding on plant microorganisms which they ingest whole, the mouth parts being modified from the normal piercing beak of Hemiptera. Several species are found in the Basin.

Semi-aquatic
Water Striders

Family Gerridae

Common Water Strider
(*Gerris remigis*)

Figure 62. Common Water Strider.

Sometimes these bugs are called "water spiders," fittingly because of their long spiderlike legs which extend out from the body and support it delicately on the water's surface. Many have noticed the strange shadows cast on the bottom of a clear, still pool by the menisci encircling the tips of the legs of these insects as they literally skate across the surface. Their light weight plus padlike feet tipped with water-repellent hairs permit them to remain on top of the surface film without breaking it.

Water striders are predaceous on all kinds of small insects, both other aquatic and semi-aquatic insects (including their own kind) and terrestrial insects which happen to fall upon the water surface.

Toad Bugs

Family Gelastocoridae

Common Toad Bug
(*Gelastocoris oculatus*)

These bugs are found on sandy or muddy shores of ponds and streams where their mottled color pattern blends with the background. Their hopping locomotion and habit of sitting on their haunches with the tip of the abdomen lowered in every way suggest a toad in miniature. They do not normally venture onto or below the surface of the water, but prefer to remain close by on the shore, catching and feeding on smaller arthropods.

The common local species is *Gelastocoris ocu-*

latus; but the rare *Nerthra martini* is also found in the Basin.

Figure 63. Common Toad Bug.

Cicadas

Family Cicadidae

Figure 64. A cicada.

The deafening, shrill, high-pitched voice of the cicada, so familiar to mid-westerners, is seldom heard locally. Only the males produce this sound with organs situated at the base of the abdomen, composed basically of a thin membrane to which strong muscles are attached. These muscles vibrate the membrane at a high frequency, setting up sound waves much in the manner of a tuning fork. The song is usually characteristic for a particular species and serves as a mating call to the female. A hearing organ (tympanum) is located at the base of the abdomen of both sexes; in the male it is actually a part of the stridulating organ.

Following courtship, the females lay their eggs in slits made by the ovipositor, in plant stems and leaves. On hatching, the nymphs drop to the ground, burrow into the soil, and suck the juices of roots. A considerable length of time is required for nymphal development, ordinarily 2 to 5 years. (One eastern and mid-western species, the Seventeen Year Cicada or Periodical Cicada, actually requires 17 years.)

Mature nymphs emerge from the ground and transform into an adult on some vertical or inclined object, frequently a tree trunk or rock. Their cast skins may at times be found still clinging to the spot where the transformation occurred.

Cicadas are often called "locusts" by easterners and mid-westerners. Doubtlessly the name was applied because some species appearing in swarms reminded early observers of migratory grasshoppers or true locusts.

Several species of cicadas occur in Los Angeles, but presently are to be found only in our few remaining native and vacant hill areas. One species (*Tibicinoides cupreosparsus*) deserves note for its small size (only ¾ inch long) and wings with a broad brilliant red zone at the base. It is found in grassy areas, into which plants the females insert their eggs.

REFERENCE: Simons, J. 1954. The cicadas of California. Calif. Insect Surv., Bull., vol. 2, no. 3.

Leaf Hoppers

Family Cicadellidae

Leaf hoppers are very common insects, found on all types of plants throughout the Basin. There are many species, all small and having generally

Figure 65. Leaf hoppers.

Figure 66. Spittle bugs: a.—froth nest, b.—adults.

the same elongate, slender shape. Though most are greenish or brownish, some sport bright blue, red, and other colors. Both the nymphs and adults have the peculiar habit of running sideways.

These insects suck plant juices and thus frequently become agricultural or garden pests.

Spittle Bugs

Family Cercopidae

Local residents are often puzzled by masses of frothy white material resembling spittle which cover parts of plants. They are surprised to learn that the froth is produced by the nymphs of these bugs and serves as a place of concealment and protection. Adult spittle bugs resemble leaf hoppers.

Tree Hoppers

Family Membracidae

Figure 67. A tree hopper.

Tree hoppers, several species of which are found locally on many kinds of plants (not just on trees as the name implies), resemble spittle bugs and leaf hoppers in their anatomy and habits, but possess a uniquely developed prothorax. This region of the body is greatly enlarged and projects upward and backward over the abdomen. The profile of this structure gives the bug the look of a thorn or roughening on a twig or branch, and in this way disguises it from predators, a remarkable example of protective form.

Aphids

Family Aphididae

Figure 68. Aphid female, giving birth to nymph.

Aphids are notorious pests of cultivated plants. Prolific breeders, their numbers swiftly spread over the tender growing tips of prize roses and other plants, from which they withdraw large quantities of sap. The result is a wilted, curled and unsightly mass, or a dead plant. The aphid's harm is increased by its habit of copiously excreting from the anus a sugary solution called "honeydew," which covers the host plant with a sticky, unsightly residue, often becoming blackened due to the growth of mold.

Honeydew is a food greedily sought after by other insects. Ants are particularly fond of this substance and certain species actually care for the aphids, moving them from place to place in order to avoid parasites and predators and to insure them safe living conditions. The ants induce the aphids to give up the honeydew (milking them) by stroking them with their antennae. This practice is responsible for the name "ant cattle," which is often applied to aphids.

Aphids are remarkable for their peculiar modes of reproduction and development associated with polymorphism (different body forms). They display life cycles so complicated and varied that they are impossible to summarize here. Parthenogenesis (development of unfertilized eggs), viviparity (live bearing) and winged and wingless generations are common reproductive phenomena.

Aphids have many enemies, particularly ladybird beetles and lacewings. For this reason these predatory insects should be encouraged to live and multiply in the home garden.

Many species of aphids occur in the Los Angeles area. Practically every kind of native and cultivated plant is susceptible to their attack. Local gardeners will be most familiar with the green Rose Aphid. (*Microsiphum rosae*).

Scale Insects

Male scale insects are rarely seen; they are tiny (1/32 - 1/16 inch), two-winged gnatlike creatures. The females, on the other hand, are all too common, but are seldom recognized as insects by the layman because of their non-insectlike body form. There are two general types, depending on whether or not the body is covered with a thick shell or scale.

Those with a shell (the so-called Armored Scales) are soft-skinned and usually pale colored. They live their entire adult life attached to one spot on the host by their tremendously long, sucking mouth parts which penetrate deeply into the plant tissue. They can be seen by carefully catching the edge of the waxy scale with a pin and flipping it up. The female insect usually comes away in the scale, her mouth parts pulling out of the plant and appearing as microscopically fine, curled hairlike filaments projecting from the body.

Unprotected by a shell are the soft scales. The outer wall of their bodies is thickened for protection but otherwise they are like the preceding group. Often, in place of a shell, they are covered with a powdery, white, waxy secretion. They characteristically attack woody plants and secrete copious quantities of honeydew.

In both groups of scale insects the nymphs are active and free-living creatures, called crawlers. Only after a molt do they attach to the host and become stationary.

We have many types of scale insects locally; the most conspicuous species are the following:

Armored Scales

Family Diaspididae

California Red Scale
(*Aonidiella aurantii*)

Figure 69. California Red Scale.

Cottony Cushion Scale
(*Icerya purchasi*)

Figure 70. Cottony Cushion Scale.

This is probably the most serious pest of citrus fruit in the world. It establishes itself readily on lemon and orange trees grown in orchards or in the garden. Although the scales cover leaves, twigs, and branches, they are easiest to see against the light background color of the ripe fruit. The reddish colored scale is roughly circular in shape with a diameter slightly more than 1/16 inch.

It is generally believed that the species was introduced into California in 1879 when six lemon trees from Australia were planted in an orange grove in Los Angeles, although there is evidence that it may have been already present.

The next species is a famous, but fortunately now not so common, unarmored scale occurring locally:

Soft Scales

Family Coccidae

The fame of this insect stems from the fact that it nearly destroyed the citrus industry in southern California just before the turn of the century. At that time the Vedalia Beetle (*Rodolia cardinalis*), a member of the Ladybird family, which has a voracious appetite for Cottony Cushion Scales, was introduced and quickly reduced the latter's numbers to harmless proportions. The case is cited today as a classic example of biological control of an insect pest.

This species is easily recognized by the attached elongated white egg sac, with fluted (grooved) edges, which usually forms a mass larger than the insect itself. The nymphs which hatch from the eggs and leave the sac are conspicuous for their bright red color.

This scale may be found on a variety of plants in addition to citrus.

Mealybugs

Family Pseudococcidae

Figure 71. Mealybug.

Mealybugs are related to the unarmored scale insects. The females are ⅛ to ¼ inch long and have oval, flattened bodies encrusted with a white, powdery wax which readily rubs off, giving a "mealy" appearance to colonies of these insects. The males resemble male scale insects. Like scale insects and aphids they are injurious to a great many cultivated plants.

Whiteflies

Family Aleyrodidae

Colonies of tiny (approximately 1/16 inch long), white mothlike insects frequently infest ornamental plants such as oak, iris and morning glory. These are adult whiteflies, so-called because of a fine white powder covering the body and wings. When disturbed, they fly from their perches in a flaky cloud.

The nymphs of some of the several local species, especially those found on the undersides of the leaves of oaks, secrete white wax plumes or ribbons from the back, giving them a flowerlike appearance.

Figure 72. Whiteflies: a.—adults, b.—nymphs.

Although the adults feed, the nymphs do most of the damage to the host plant in a manner similar to aphids, scale insects, and mealybugs, by withdrawing great amounts of sap.

Thrips

Order THYSANOPTERA

Extremely tiny (less than 1/16 inch long), these insects are hardly noticed by the layman except when they injure garden plants with their feeding. A common symptom of their attacks is leaf curl, resulting from the loss of the leaf's sap to the thrips' rasping-sucking mouthparts.

Magnified greatly, thrips are seen to possess unique wings, very long and narrow with few or no veins and fringed with long hairs.

Figure 73. Greenhouse Thrips, adults.

Thrips live on plants and are especially common in flowers, particularly daisies and dandelions. Sometimes they accidentally fall onto human skin and prod about with their strong mouthparts, causing a biting sensation.

Species too numerous to mention occur in the Basin. Perhaps the commonest are the Western Flower Thrips (*Frankliniella occidentalis*) and Greenhouse Thrips (*Heliothrips haemorrhoidalis*).

Nerve-winged Insects

Order NEUROPTERA

The common name of this group refers to the complex nervelike pattern of veins which ramifies through the wings. These insects are soft-bodied and generally fly poorly, in spite of the well-developed, twin pair of wings. Being primarily predaceous, in both the larval and adult phases, they often benefit man by eating insect pests.

The order attains its greatest diversity in Australia; comparatively few species live in our area:

Dobsonflies

Family Corydalidae

California Dobson
(*Neohermes californicus*)

Figure 74. California Dobson.

This is a stream-loving species, found sporadically in the Santa Monica Mountains and the northern foothills (common at higher elevations in the San Gabriels). It is conspicuous because of its large size (wing expanse, 3-3½ inches) and habit of coming to light at night.

The larvae are aquatic and hide among leaf and twig debris jams in small, rapid flowing streams. Commonly called hellgrammites, they prey on other aquatic insects, chiefly mayfly and caddisfly larvae. The pupae are very active and crawl onto sticks and leaves that accumulate as the streams dry up.

Eggs are deposited in oval masses on exposed, flat surfaces of rocks and wood. Young larvae pass the dry summer in dormancy under rocks and debris in contact with the moist stream bed.

REFERENCE: Smith, E. 1970. Biology and structure of the dobsonfly, *Neohermes californicus* (Walker) (Megaloptera: Corydalidae). Pan-Pacific Entomol., vol. 46, pp. 142-150.

Family Raphidiidae

Snakeflies
(*Agulla* species)

Figure 75. Snakefly.

The elongate prothorax and projecting head, suggesting the raised fore quarter of a snake, are responsible for the common name of these insects. Several species are found in our area. Adults are sometimes common on shrubbery and trees in the springtime, mainly in hilly areas. They feed on small, soft-bodied insects, including young scale insects, aphids, and mites, etc., and thus are of benefit to the farmer and gardener. They will eat larger insects if the latter are injured and unable to escape or defend themselves.

The larvae have similar tastes and will devour caterpillars and other insect larvae as well. Larvae sometimes live under empty shells of scale insects. Mature larvae hibernate in accumulated dry leaves, in vegetation, on the ground, under bark, and in porous wood.

REFERENCE: Acker, T. 1966. Courtship and mating behavior in *Agulla* species (Neuroptera: Raphidiidae). Entomol. Soc. Amer., Ann., vol. 59, pp. 1-6.

Green Lacewings

Family Chrysopidae

Common Green Lacewing
(*Chrysopa oculata*)

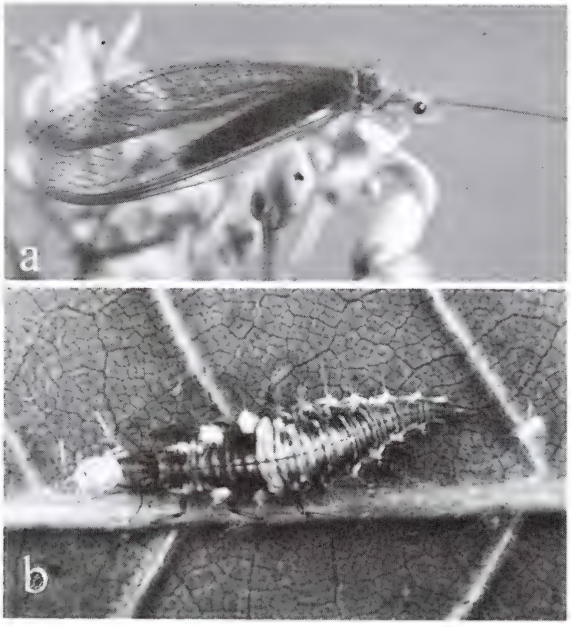


Figure 76. Common Green Lacewing: a.—adult, b.—larva.

During the warmer parts of the year this species rests near porch lights to which it has been attracted during its nocturnal wanderings. The light may cause the eyes to reflect like brilliant golden beads, hence the name "Golden Eyes" sometimes placed on these fragile, green-tinted insects.

The larvae are called "aphid lions," a name needing no elucidation; they have voracious appetites for aphids and similar injurious plant pests which they catch with their sickle-shaped jaws. The young larvae are so cannibalistic that the eggs, which are laid in a group on the surface of a leaf, would not survive if it were not for the fact that they are placed on long, slender silken stalks, out of the reach of precocious, newly-hatched individuals. The adults probably take no food.

Other species occur generally through our area, though less commonly than *oculata*. They are all very similar and indistinguishable to the untrained eye.

REFERENCE: Smith, R. 1922. The biology of the Chrysopidae. Cornell Univ. Agr. Exp. Sta., Mem. 58.

Brown Lacewings

Family Hemerobiidae

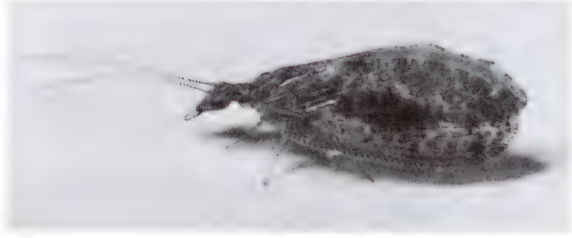


Figure 77. Brown Lacewing.

Very similar in structure and habits to the green lacewings, these Neuroptera may be distinguished mainly by their slightly smaller size and brownish color; the wings of brown lacewings also are covered by microscopic bristles which collectively give them a velvety or dull appearance.

The larvae are predaceous, like those of green lacewings, and often pile bits of debris on their backs to give them a measure of camouflage.

Several genera and species live in the Basin. They are difficult to distinguish and will not be enumerated.

Ant Lions

Family Myrmeleontidae

These insects are known to most of us only by the funnel-shaped pits dug by the larvae of a few

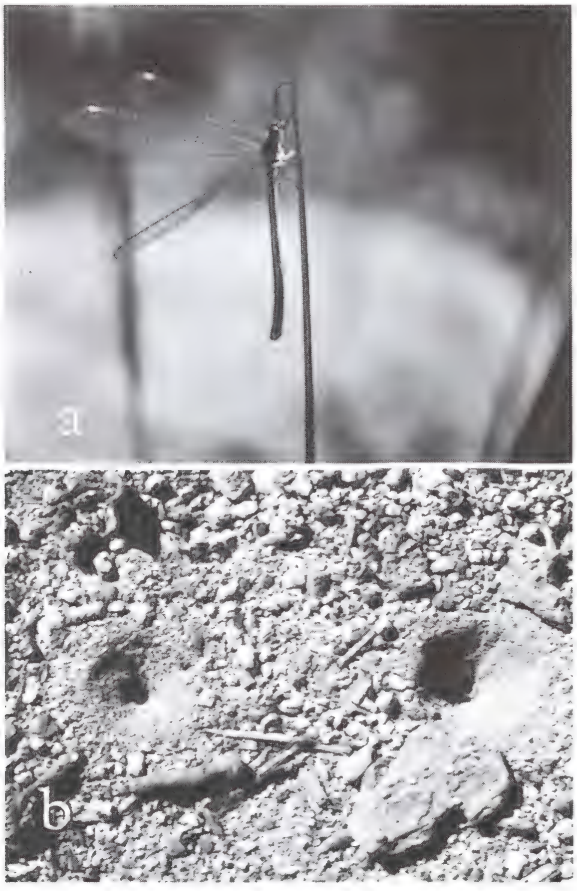


Figure 78. Antlions: a.–adult *(Brachynemurus),* b.–pits *(Myrmeleon).*

genera (primarily *Myrmeleon*). The latter lie buried at the bottom of the pit with only their sickle-shaped jaws protruding from the soil, ready to catch any unsuspecting prey–often an ant–that happens to tumble into the trap. The traps are typically dug in fine sandy soil in protected places. The slope of the funnel is adjusted just at the critical angle of repose for sand, so that the sides readily give way under the feet of the would-be-escapee, sliding it back into the terrible jaws at the bottom of the pit. The larva makes matters worse for the prey by throwing sand onto it.

Ant lions are also called "doodle bugs." Country boys of earlier generations know that it can be enticed to leave its pit by pronouncing the magic phrase, "Doodle bug, doodle bug, come out of your hole." (Actually, of course, the expirations of the voice with these words, which must be spoken very close to the pit, dislodge some sand and the doodle bug, believing it has made a capture, becomes excited and active and crawls out into view).

Adult ant lions are long, gracefully slender creatures with four similar, speckled wings. Their antennae are characteristically short and clubbed. Though feeble fliers, they often come to lights.

Several species, belonging to the genera *Brachynemurus* and *Myrmeleon,* occur in the Basin.

REFERENCE: Herbert, H. 1936. Insect of prey. Natur. Mag., vol. 27, no. 2, pp. 80-83.

Caddisflies

Order TRICHOPTERA

Figure 79. Caddisfly *(Hesperophylax).*

These insects look a great deal like moths, but they lack the long, coiled sucking mouthparts that most moths have, and they have hairs on the wings instead of scales. They occur near water, frequently coming to lights at night. Aquatic bottom dwellers, the larvae are well known to stream fishermen as "caseworms." Those of most species live in some sort of protective case or tube made of silk, with bits of leaves, twigs, sand grains, pebbles, or other material incorporated into the case to give the larvae additional physical protection and camouflage. The variety of such "mobile homes" is extensive, some being purse-shaped, tubular, curved, snail-shaped, rectangular, etc., and there are even types with sticks set in an ascending square framework, mimicking little log cabins.

Very few species occur in the Basin itself, but numerous species dwell in the streams of the Santa Monica and San Gabriel Mountains. Species of the genus *Hesperophylax*, are most striking, characterized by light brown fore wings with longitudinal silver streaks. The larvae of this genus build cylindrical cases of small stones and live in clear, swift mountain streams.

Butterflies and Moths

Order LEPIDOPTERA

The Lepidoptera are a large and generally homogeneous order, characterized by the presence of microscopic, overlapping scales on the surfaces of the wings. These scales are easily dislodged and adhere to the fingers like fine powder if the wings are rubbed. The insect's color pattern is actually a mosaic of colored scales; without them the wing membrane is semi-transparent and colorless.

With the exception of a very few primitive mandibulate moths, all butterflies and moths have a uniquely fashioned set of mouthparts. These consist of a long pair of slender, grooved filaments which interlock so that a canal is formed between them. The insect uses this tongue or proboscis exactly like you or I would use a soda straw, dipping the tip into the liquid food and siphoning up the fluid. When not in use the tongue is kept coiled up like a watch spring under the head. In many species these mouth structures are secondarily vestigial and the adult does not feed.

Despite the fact that we refer to the Lepidoptera as butterflies and moths, the two groups are by no means equivalent in size or degree of evolutionary divergence. Moths, which constitute the vast majority of Lepidoptera, are more primitive and more generalized than butterflies and are primarily nocturnal. Butterflies comprise a relatively small side branch of the main lepidopteran family tree and are specialized mainly for a diurnal existence. Nevertheless, the division is popularly considered equal and many people ask "What is the difference between moths and butterflies?" To this question there are several answers, none of which always holds true, but, if the majority of the following six conditions apply to a specimen in hand, one can usually make a correct identification:

Butterflies

1. Wings usually held together vertically over back when at rest.
2. Pupa almost never enclosed in a cocoon; a naked chrysalid.
3. Antennae slender, swollen at the tip to form a club.
4. Body relatively slender in proportion to wings (except Skippers)
5. Diurnal (active in the daytime).
6. Hind wing coupled to forewing by the enlarged basal angle.

Moths

1. Wings usually held roof-like over the body when at rest.
2. Pupa often enclosed in a cocoon or in the soil.
3. Antenna varied in form, "feathery" to hairlike, rarely knobbed.
4. Body usually broad in proportion to wings.
5. Mostly nocturnal (active at night).
6. Hind wing usually coupled to fore wing with a frenulum (small spine)

Raising Caterpillars

There is no better way to witness the miracle of insect metamorphosis than to raise butterflies and moths from their caterpillars. Furthermore, most species of Lepidoptera are known only in the adult stage; it is usually necessary to rear caterpillars through to the adult stage in order to determine their identity.

Most caterpillars do not require a great deal of care. By following the rules outlined in the section on Keeping Insects in Captivity, success can be attained most of the time. It will be easier to carry through specimens that are nearly or already full grown to begin with than larvae hatched from eggs. One must be especially careful in any case to provide fresh leaves of the proper food plant.

A simple cage for rearing larger specimens can be made from plastic window screen, cardboard ice-cream cartons, and soft drink bottles. Sprigs or twigs of the food plant should be inserted into water in the bottle to keep them fresh. The bottom portion of the ice-cream carton should be filled to a depth of about 2 inches with loamy soil topped with dry leaf litter when the caterpillars approach maturity. Not all species spin cocoons or form hanging chrysalids; in fact, most moth larvae burrow into soil to pupate. The pupae may be dug up a few days after the larva enters the ground and laid on the surface. They will emerge normally and are less prone to develop harmful molds than those left underground. It will be necessary to sprinkle such naked pupae with water once in a while, however, to prevent desiccation.

After pupation the time required for development and emergence varies greatly with each species of butterfly or moth. Some will come out after a minimum of about ten days; others will pass a single summer or winter; still others may remain dormant for several years. When one does not know when to expect emergence, provision must be always ready. Give the newly emerged adult some rough surface to climb upon (a cylinder of toweling paper is good) so that it may fill out its wings properly.

Many lepidopterous larvae are too small to be kept in the manner described. These are best reared

in simple, large, stoppered, plastic, pill vials. Food will keep well since the humidity remains high but the chamber will have to be cleaned frequently to avoid undesirable mold growth.

REFERENCES: Crotch, W. 1956. The know-how. Part 1 *in* Crotch, W. A. silkmoth rearer's handbook. Amateur Entomol. Soc., London.
McFarland, N. 1964. Notes on collecting, rearing and preserving larvae of macrolepidoptera. Lepid. Soc., Jour., vol. 18, pp. 201-210.
McFarland, N. 1964. Additional notes on rearing and preserving larvae of macrolepidoptera. Lepid. Soc., Jour., vol. 19, pp. 233-236.

Moths

The very word *moth* strikes terror in the heart of the housewife. In defense of her woolen sweaters and blankets, she annihilates every hapless moth that chances to enter the home. The real culprits are merely a few species of tiny, inconspicuous moths that go unnoticed while the innocent vegetarian species are needlessly killed.

REFERENCES: Holland, W. 1903. The Moth Book. Doubleday, Garden City.
McFarland, N. 1965. The moths (Macroheterocera) of a chaparral plant association in the Santa Monica Mountains of Southern California. J. Research Lepidoptera, vol. 4, pp. 43-74.

The following (including the true clothes moth) are only a few of the more than one thousand species found in the Basin:

Giant Silk Moths
Family Saturniidae

Ceanothus Silk Moth
(*Hyalophora euryalus*)

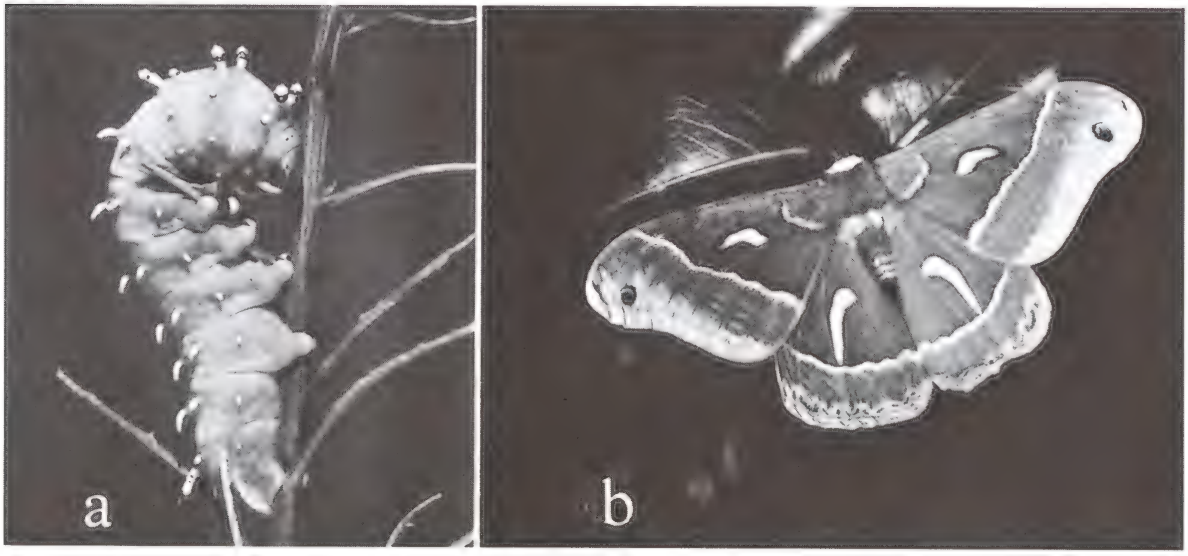


Figure 80. Ceanothus Silk Moth: a.—larva, b.—adult male.

This is a spectacular moth with its pleasing, warm, reddish-brown color and large size (wing expanse up to seven inches). It usually occurs only in the foothill areas and canyons, where males fly to lights in March and April.

During the summer the larvae feed primarily on species of Mountain Wild Lilac (*Ceanothus*) in the chaparral plant association. It is in such areas that the adults are most common. In captivity the caterpillars will also feed readily on willow, Manzanita, (*Arctostaphylos*) and other shrubs and trees. When mature, they attain giant size (up to 4 inches long) and resemble fat, powdery-green sausages set with yellow and bluish tubercles.

The gray, flask shaped cocoons are spun on the host plant in the fall.

Unmated females emit a chemical scent, from glands situated at the tip of the abdomen, which travels on air currents great distances to attract members of the opposite sex. It is a powerful sexual stimulant to the males; they lose no time flying to "calling" females and quickly mate. During copulation the female withdraws the glands and she loses any further attractiveness to other males.

The adults have atrophied mouthparts and do not feed. They die shortly after completing their sole function of reproduction.

Polyphemus Moth
(*Antheraea polyphemus*)

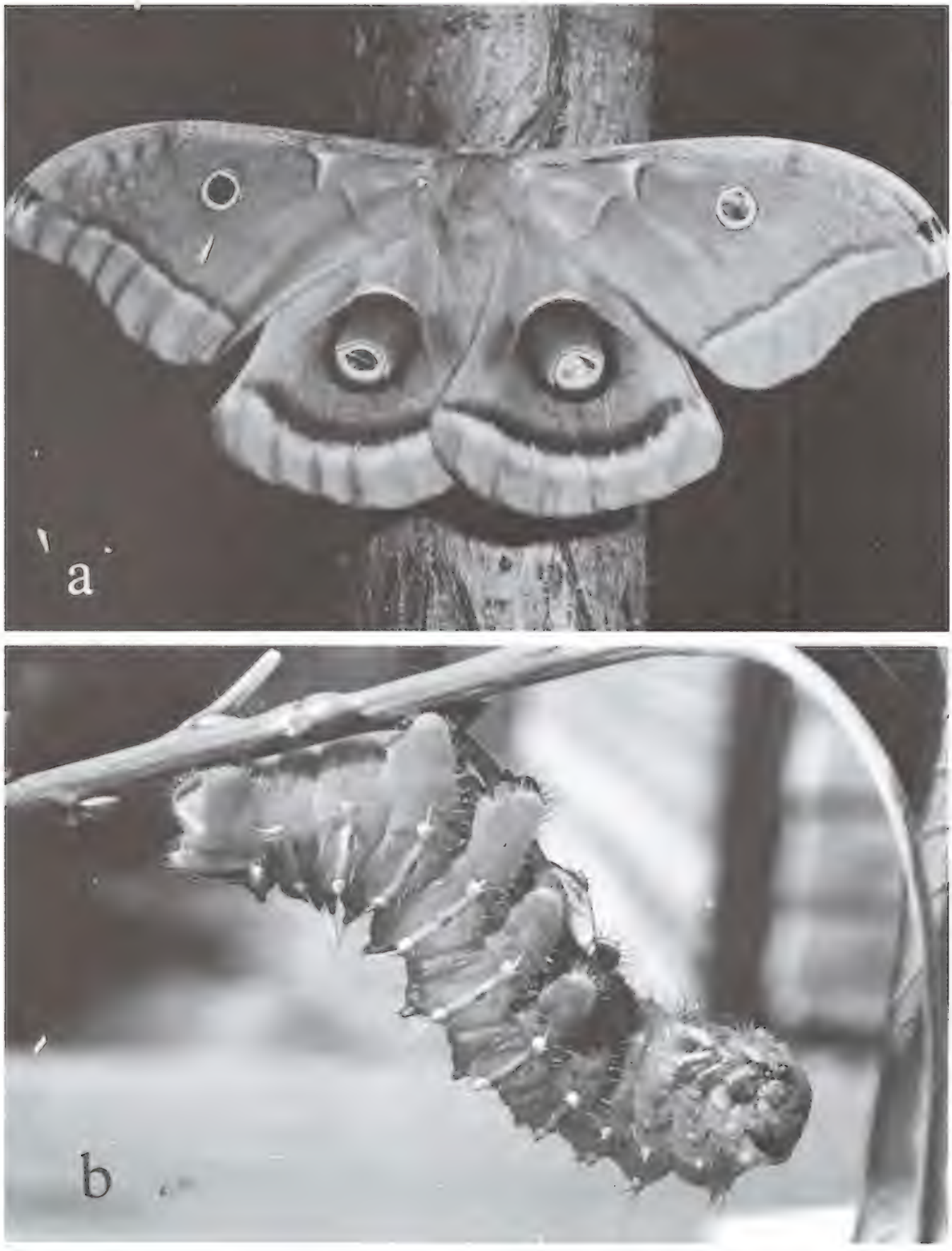


Figure 81. Polyphemus Moth: a.—adult female, b.—larva.

The principal recognition feature of this moth is the large eye spot on the hind wings. The species occurs only sporadically in the Basin, usually in the vicinity of the favored larval food plants, Coast Live Oak, birch and elm.

Mature larvae have strongly convex segments and are pale, translucent green with diagonal silver lines on the sides and pearl-colored tubercles on the back. They feed through the summer and early fall.

Cocoons are spun in the fall and drop from the trees onto the ground. Bits of leaf or small twigs are usually incorporated into the cocoon walls and help to camouflage it among the litter at the base of the host plant.

Adults fly from May to October. Like the preceding species, Polyphemus Moths have reduced, non-functional mouthparts and are attracted to lights at night. The females also emit a powerful male attractant.

Silk Moths

Family Bombycidae

Domestic Silk Moth
(*Bombyx mori*)

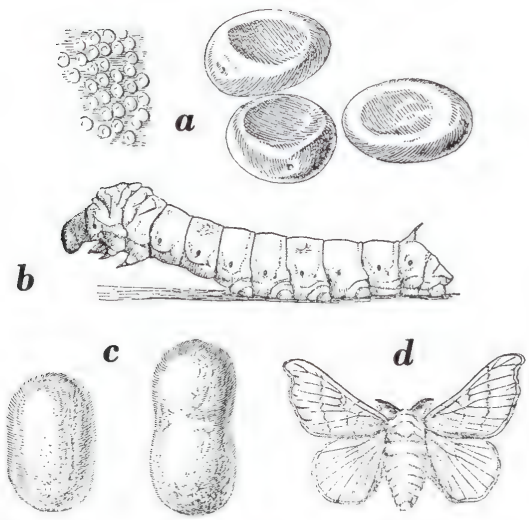


Figure 82. Domestic Silk Moth: a.–eggs (enlarged at right), b.–larva, c.–cocoons, d.–adult female. (From Essig, E. 1945. Univ. California, Agr. Expt. Sta., Cir. 363, fig. 1-4)

Neither this moth nor its caterpillar will be seen out of doors here in the Basin or anywhere else, for this is a totally domesticated insect which cannot survive without man's constant care. The species has undergone centuries of selective breeding which has improved the quality of its silk but, at the same time, has robbed it of self sufficiency; though wings remain, they are stunted and weak and no longer serve their intended purpose.

Man's long interest in this insect comes from the larva's ability to spin a very long, continuous fiber of unrivaled strength, smoothness and luster. The fiber is wound into thread which in turn is woven into a fabric known to everyone as silk, the "queen of textiles."

Sericulture (the commercial rearing of silkworms) is almost as old as history itself. The discovery of silk dates back at least 4 thousand years and is attributed to the Chinese empress Si-ling, who let a cocoon which she was fondling fall accidentally into a cup of hot tea. As she retrieved it, she discovered the strands of the cocoon when they became loose between her fingers. She experimented with the weaving of this fiber and from the results evolved the silk industry.

The modern processing of silk (steps defined under the term "filature") begins with the unwinding of the cocoons. They are first floated in pans or troughs of hot water. The strands are then wound onto spools and later cleaned, dried and subjected to various throwing and looping maneuvers to form threads of sufficient size and strength to be woven into cloth.

Today, sericulture and trade in raw silk are still important industries, primarily in oriental countries, in spite of the many popular synthetic substitutes. The many effors to establish the industry in North America and even in California have all failed for one reason or another.

The life cycle of the Domestic Silk Moth is familiar to generations of school children as the classic example of insect development and metamorphosis. The eggs (sometimes called "seed") are still readily available to teachers and the inquisitive wishing to see the transformations of this famous insect.

The smooth spherical eggs are first yellowish-white, turning dark as the embryo develops. The caterpillars are powdery-white, naked, and have a short anal horn. They remain healthy and grow steadily (maturing in about 45 days) only on the leaves of the mulberry tree (*Morus*). Broods forced to feed on substitute hosts seldom do well.

The oval, white or yellow cocoons are spun in a cage corner or clump of twigs. After 12-16 days the adults emerge through one end of the cocoon which has been softened by a caustic secretion from the pupa.

REFERENCES: Cooper, E. 1961. Silkworm and science, the story of silk. Harcourt, Brace, World, N.Y.
Yokoyama, T. 1963. Sericulture. Annual Rev. Entomol., vol. 8, pp. 287-306.

Sphinx Moths

Family Sphingidae

These moths feed while in flight, hovering before a flower as they dip their tongues in and out like a humming bird. For this reason, members of the family are sometimes called Humming Bird Moths. (Hawk Moths is yet another name.) The more common name, Sphinx Moths, stems from the fright posture of the larva with its fore quarter reared back and head tucked under, suggesting the historical Sphinx edifice in Egypt.

The larvae of nearly all species have an erect spine or horn at the posterior end. Though formidable, it is harmless and is apparently only "for show" to discourage predators.

Tomato Sphinx
(*Manduca sexta*)

Many people do not know that the large green "tomato worms," which reduce their backyard tomato vines to a state of rubble in the summer, later turn into large sphinx moths. When mature (4 inches long), these caterpillars crawl to the ground and burrow two to six inches below the surface in order to pupate. The pupa is notable for its large size (2 inches) and curious "jug handle" appendage, which is actually a case for the developing proboscis of the adult. When extended this proboscis may be 3½ - 4 inches long and provides the moth with an efficient means for stealing nectar from deep throated flowers.

The mottled gray fore wings of the adult span 4 - 4½ inches. Also to identify it is a row of six large orange spots on each side of the abdomen.

There are two generations per year of this species in the Basin. Fall pupae remain in the ground until the following summer; summer pupae produce adults after only a week or two. The caterpillar feeds on many plants of the Nightshade family in addition to tomato: potato, tobacco, Indian Tobacco (*Nicotiana glauca*), Jimson Weed (*Datura*), etc.

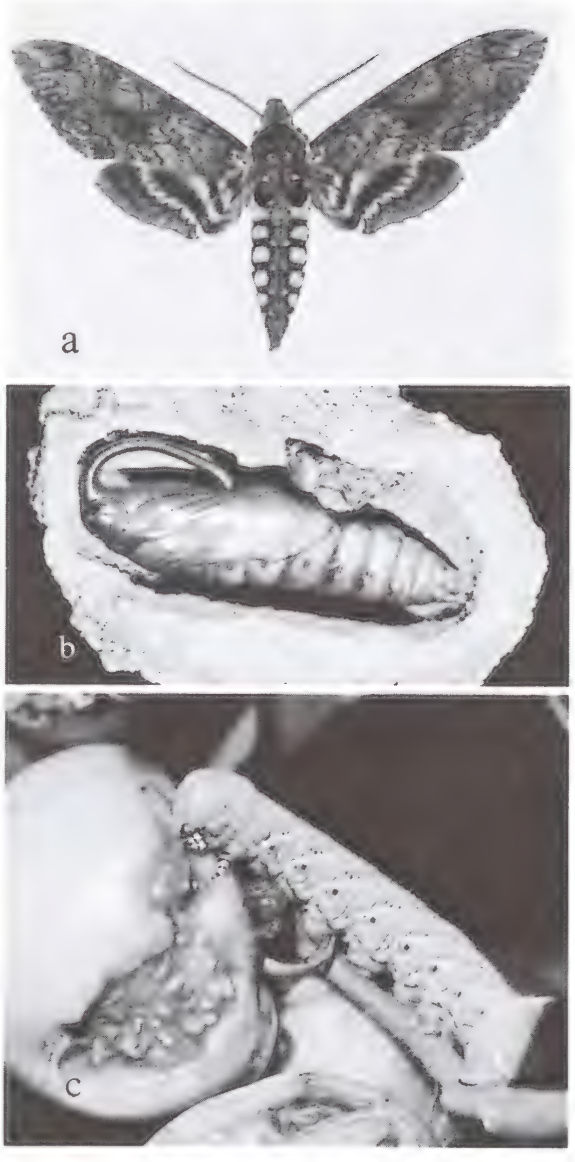


Figure 83. Tomato Sphinx: a.—adult, b.—pupa, c.—larva.

White-lined Sphinx
(*Hyles lineata*)

Also called the Striped Morning Sphinx, this is one of our commonest moths. It may often be caught at rest near the lights of store fronts during the summer, even in the metropolitan area.

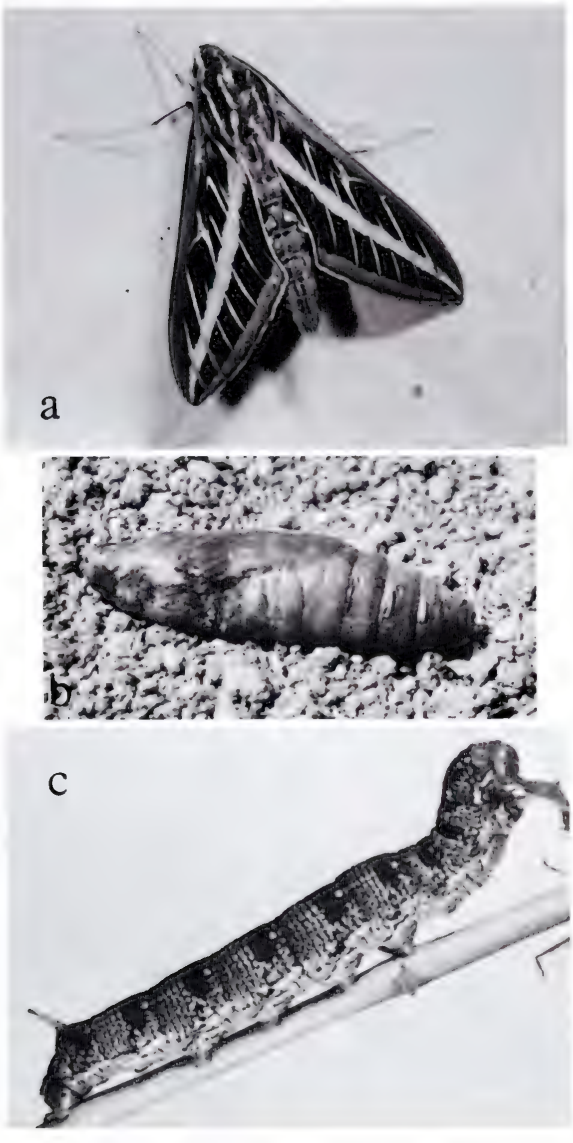


Figure 84. White-lined Sphinx: a.—adult, b.—pupa, c.—larva.

The larvae, which come in black as well as green color phases, may literally swarm on desert vegetation in the spring. Like the tomato hornworm, the caterpillar goes into the ground to pupate; the pupa lacks the "jug handle," however, even though the adult has a fairly long tongue. The list of larval food plants is almost infinite; a common local host of importance is fuchsia.

Tussock Moths

Family Lymantriidae

Western Tussock Moth
(Orgyia cana)

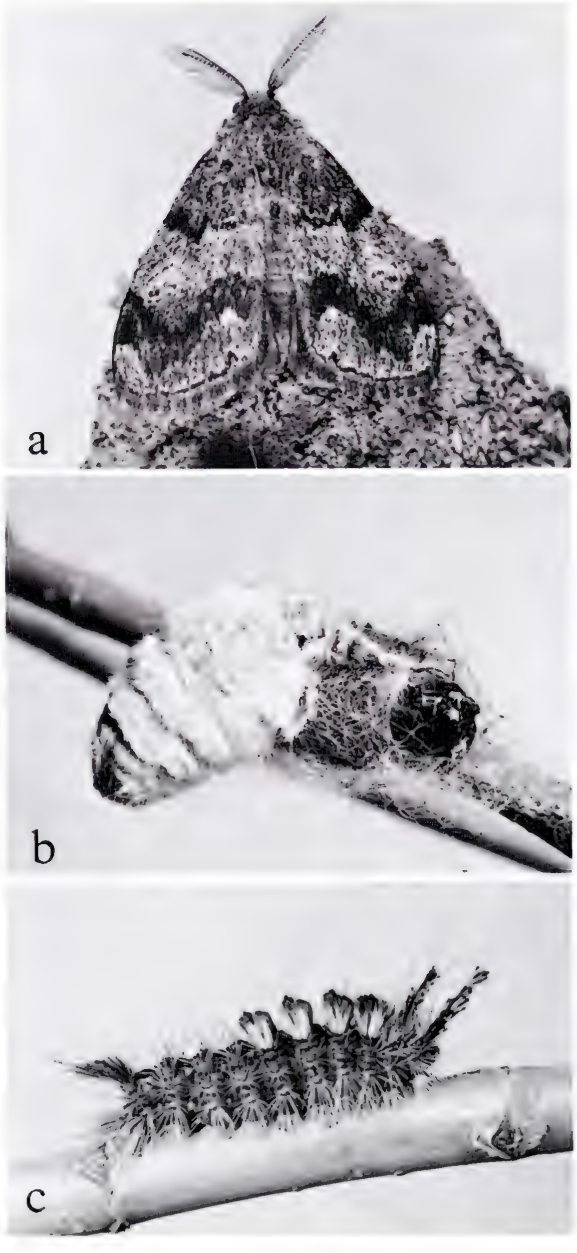


Figure 85. Western Tussock Moth: a.—adult male, b.—female (on cocoon), c.—larva.

The furry caterpillar of this species feeds on a variety of plants in the Basin, most commonly rosaceous types (pome fruits, pyracantha) but also Coast Live Oak (*Quercus agrifolia*). Fullgrown specimens are about one inch long, with numerous red, blue, and yellow spots, and varied tufts of hairs, the most characteristic being the dense, erect

group of four on the back of the anterior abdominal segments. These hairs easily dislodge and occasionally cause a skin reaction or allergy in sensitive persons contacting them. The caterpillars incorporate these hairs into their cocoons.

The male moth is normal looking but the female resembles a flightless, stubby-winged, furry bag that never crawls far from its cocoon. It lays its eggs in gray, felt-covered masses. The adults are active from May to July and again my be seen from a second brood in September and October. Winter is passed in the egg stage. Larvae are most common in March, April, and May.

The species is distributed sporadically through the Basin, although it is most common in the foothill canyons and on the surrounding slopes; it also occurs along the immediate coast.

REFERENCE: Atkins, E. 1958. The western tussock moth, *Hemerocampa vetusta* (Bdr.), on citrus in southern California. J. Econ. Entomol., vol. 51, pp. 762-765.

Owlet Moths

Family Noctuidae

This is the largest family of Lepidoptera; there are probably more than 200 species in the Basin. They are the common, dull colored moths or "millers" seen around lights throughout most of the year. Some species even fly during the coldest nights in January.

Owlet moths differ from the geometers, which are also common locally around lights, principally by the heavier body and resting posture with wings held rooflike over the body; geometers have relatively slender bodies and rest with wings upright like a butterfly or at right angles to the body and appressed to the substratum.

A further characteristic of Owlet Moths is the tympanum or "ear" located below the hind wing in the wall of the metathorax. It is composed of a thin taut tympanic membrane from which two auditory nerve fibers run to the central nervous system. Recent investigations have shown that the "ear" does function as a hearing organ and is tuned in particularly to the ultra-high frequency band of sound emitted by bats. Experimental specimens have been observed to perform diversionary flight maneuvers when recorded bat noises were trained in their direction.

The caterpillars of many species of this family are plant pests. One group in particular, the cutworms, are notable for the surreptitious manner in which they cause injury, curling up and hiding in the soil during the daytime and feeding on the roots or neatly nipping off plants at ground level under the protection of darkness. Also, the armyworms and many of the fruit worms, stalk borers and loopers, also agriculturally and horticulturally important types, belong to this family.

Most species pupate underground in an earthen cell. Upon hatching, the moth has to push through several inches of soil to reach the surface.

REFERENCE: Roeder, K. and A. Treat. 1961. The detection and evasion of bats by moths. American Scientist, vol. 49, no. 2.

Some of the more important Noctuidae occurring in our area are these:

Corn Earworm
(*Helicoverpa zea*)

Figure 86. Corn Earworm, adult.

Housewives and cooks discover this species when they open a fresh ear of corn and find one or two, inch and-a-quarter, brownish-striped caterpillars unashamedly stealing the terminal kernels and dropping copious quantities of unsightly brown fecal matter. Corn Earworms yearly destroy or devalue thousands of dollars worth of sweet corn in this manner.

The moth has a wing span of about 1¼ inches and is light brown in general color with dark spots on the fore wing and a brown marginal band on the hind wings. Females deposit their eggs on the silk of young ears and the larvae gain access to the kernels by eating through the developing tassel. The caterpillars also cause severe damage to tomatoes, beans, bell peppers, cotton, geraniums, and other plants.

REFERENCE: Hardwick, D. 1965. The corn earworm complex. Entomol. Soc. Canada, Mem., 40.

Common Cutworms

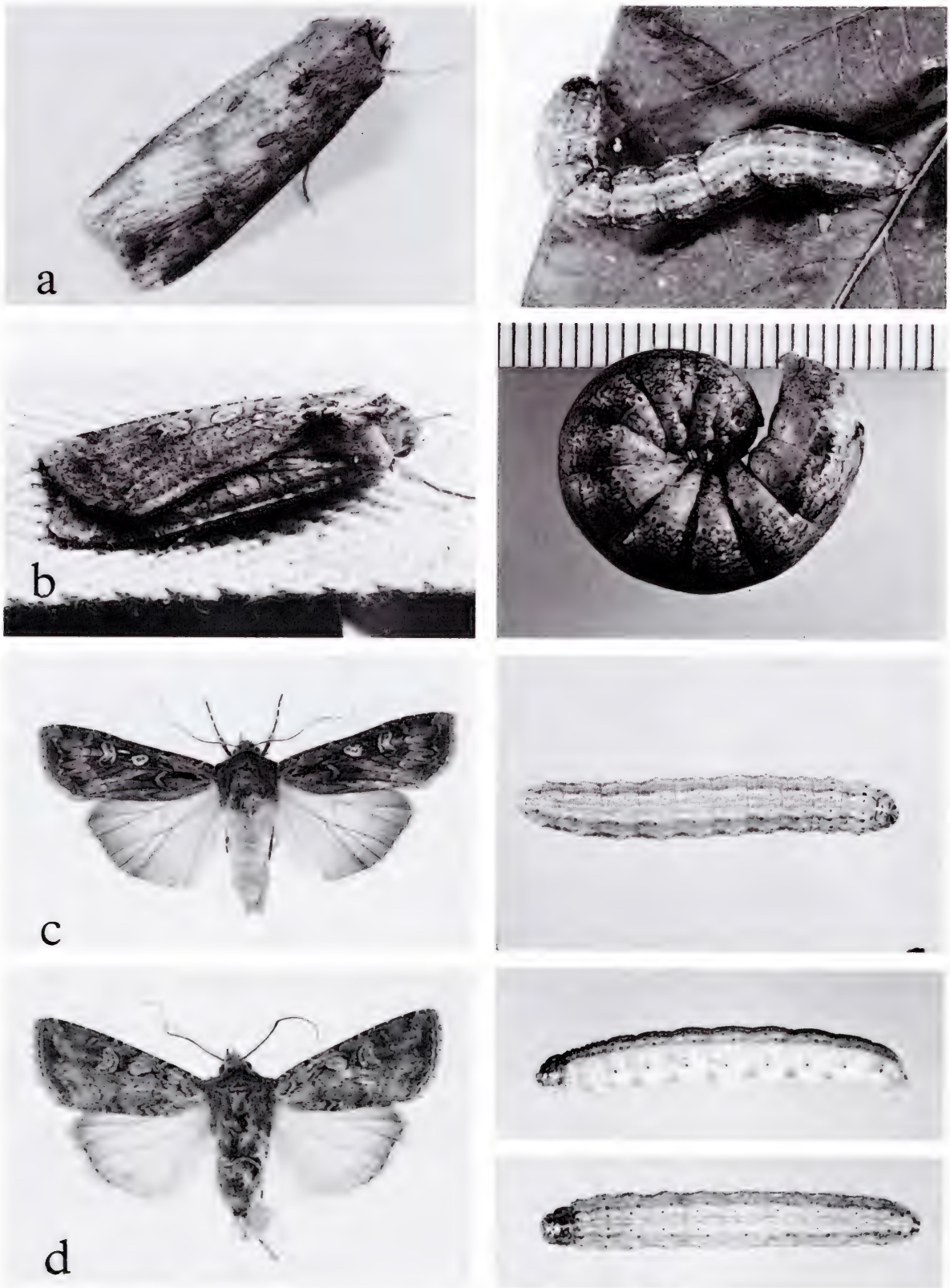


Figure 87. Common Cutworm species, adult (left), larva (right): a.—Black Cutworm, b.—Variegated Cutworm, c.—Army Cutworm, d.—Dark-sided Cutworm.

Common Cutworms

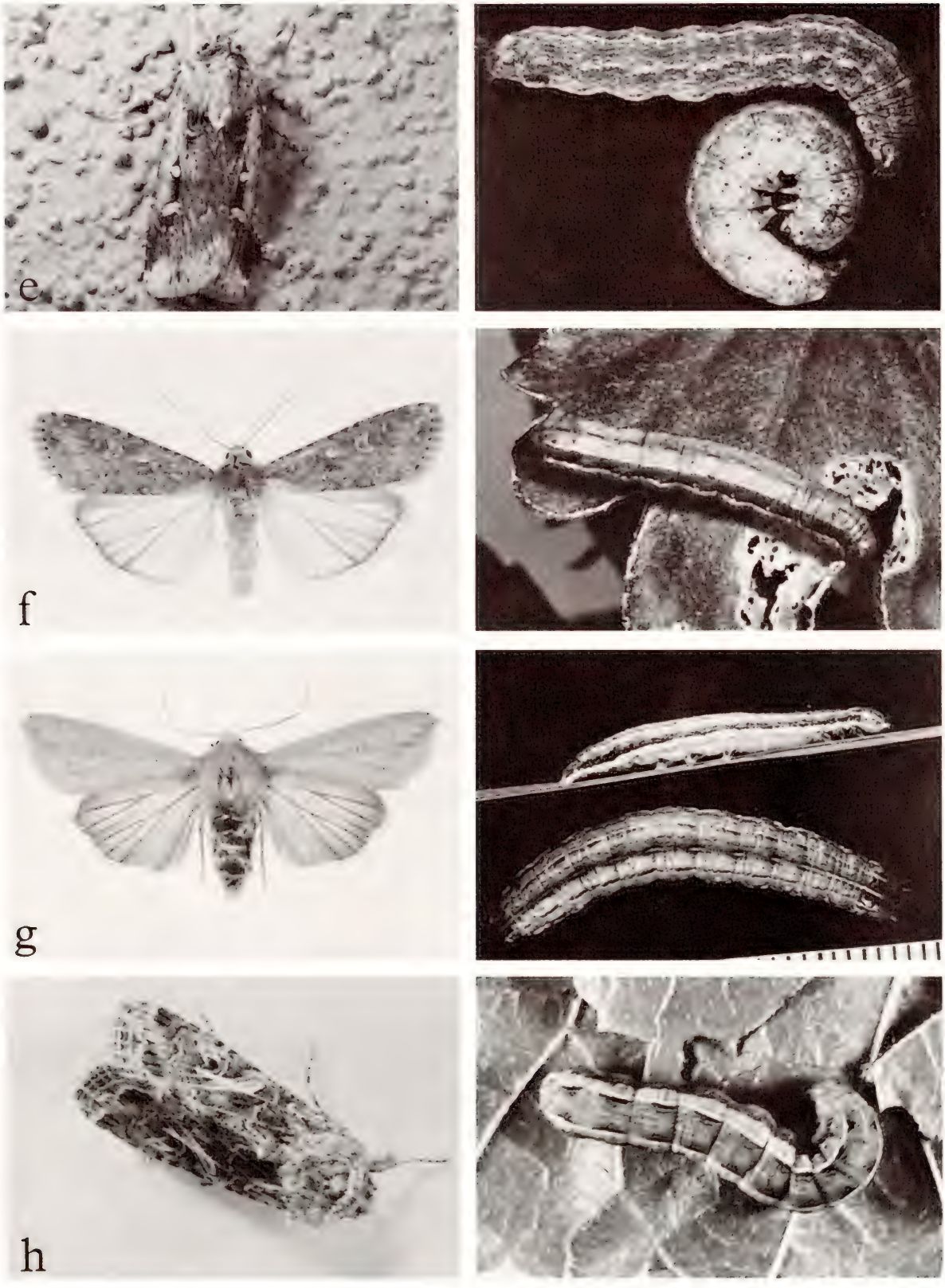


Figure 87. Common Cutworm species, adult (left), larva (right): e.—Granulate Cutworm, f.—Beet Armyworm, g.—Armyworm, h.—Yellow-striped Armyworm.

Our common cutworms are listed below. They are described by color only; see the figures to identify them and the adults. All are general feeders on most kinds of low growing, herbaceous vegetation including grasses.

1. Black Cutworm (*Agrotis ipsilon*).

Greasy grey to brown above, with faint lighter stripes.

2. Variegated Cutworm (*Peridroma saucia*).

A distinct pale yellow or orange dot on the middle of the back of most segments; frequently a dark "W" mark on the 8th abdominal segment.

3. Army Cutworm (*Chorizagrotis auxiliaris*).

Pale yellowish grey-brown with back pale striped and finely splotched with white and brown; no distinct prominent marks.

4. Dark-sided Cutworm (*Euxoa messoria*).

Dull grey, darker on the sides. A distinct white line runs longitudinally below the spiracles.

5. Granulate Cutworm (*Feltia subterranea*).

Dingy brown; broad buff-grey dorsal stripe subdivided into triangular areas on each segment and margined by a narrow dark stripe on each side.

6. Beet Armyworm (*Spodoptera exigua*).

Pale or olive green above with a dark dorsal stripe and yellow stripe beneath this; entire under half pale yellow or cream.

7. Armyworm (*Pseudaletia unipuncta*).

Greenish brown or gray with three yellowish stripes along the back and a broad, darker yellow stripe on each side.

8. Yellow-striped Armyworm (*Spodoptera ornithogalli*).

A pair of black triangles on the back of most segments and commonly with a bright orange stripe just outside of these spots on each side. Young larvae are largely black.

REFERENCES: Crumb, S. 1956. The larvae of the Phalaenidae. U.S. Dept. Agric., Tech. Bull., 1135.
Godfrey, G. 1972. A review and reclassification of larvae of the subfamily Hadeninae (Lepidoptera, Noctuidae) of America north of Mexico. U.S. Dept. Agric., Tech. Bull., 1450.

Loopers
(*Autographa* species)

Three species of loopers are common in the Basin, so called because the larvae lack the two anterior pairs of abdominal prolegs, forcing them to walk by looping the body in inchworm style:

Alfalfa Looper
(*Autographa californica*)

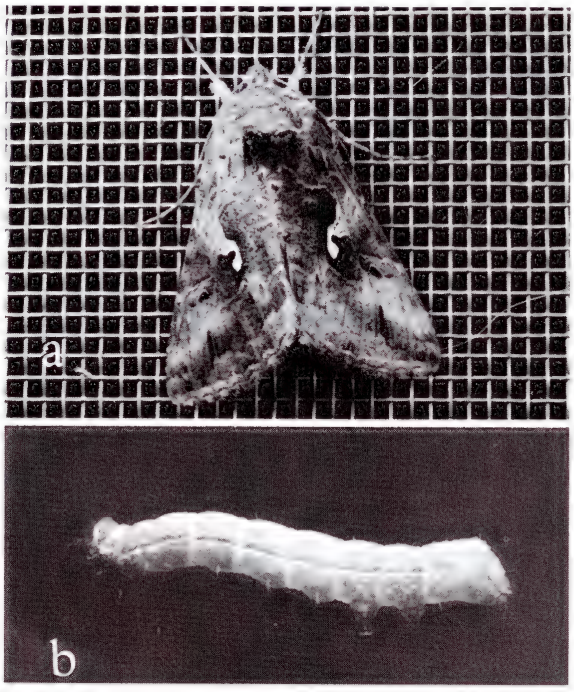


Figure 88. Alfalfa Looper: a.—adult, b.—larva.

The moth is generally gray with a silver mark resembling the Greek letter "gamma" near the middle of the fore wing. It normally flies to flowers at dusk, but frequently it pursues its activities in broad daylight. The larva is a general feeder.

Cabbage Looper
(*Trichoplusia ni*)

This species is similar to the preceding but the moths are more brownish in general color. The larvae prefer cruciferous plants, especially cabbage, but will feed on the leaves of a variety of other plants. In southern California, the species is regarded as one of the most important insects attacking agricultural crops.

NOTE: This species was known as *Autographa brassicae* in earlier literature.

REFERENCES: Shorey, H. and R. Hale, Jr. 1965. Cabbage looper, a principal pest of agricultural crops in California. Calif. Agric., vol. 19, pp. 10-11.

Shorey, H., L. Andres and R. Hale, Jr. 1962. The biology of *Trichoplusia ni* (Lepidoptera; Noctuidae). I. Life history and behavior. Entomol. Soc. Amer., Ann., vol. 55, pp. 591-597.

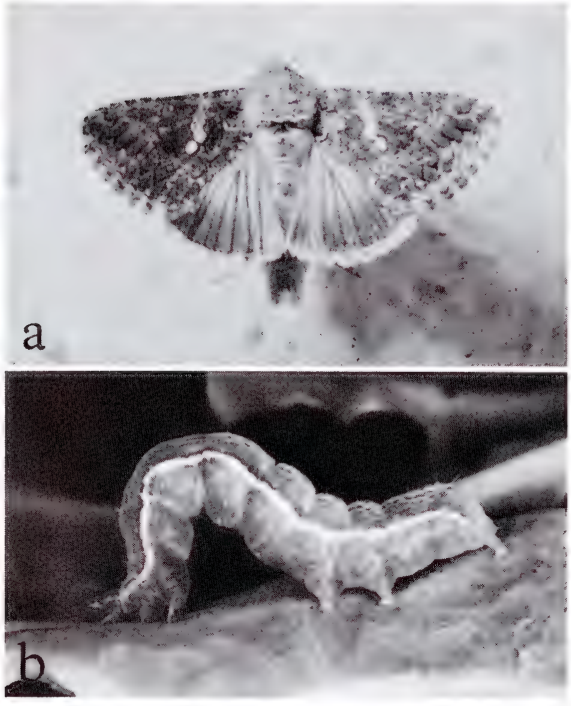


Figure 89. Cabbage Looper: a.—adult, b.—larva.

Chocolate Looper
(*Autographa biloba*)

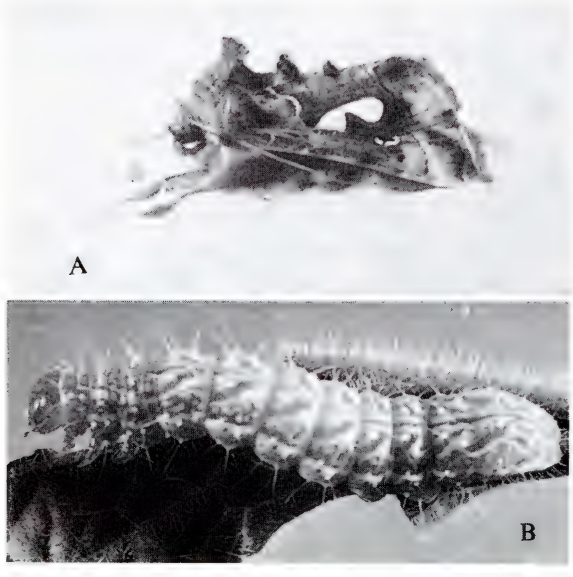


Figure 90. Chocolate Looper: a.—adult, b.—larva.

The moth has rich, dark-brown forewings marked with a distinct bilobed silver mark, which, in silhouette, resembles a man's house slipper. The larva is a general feeder.

Black Witch
(*Otosema odora*)

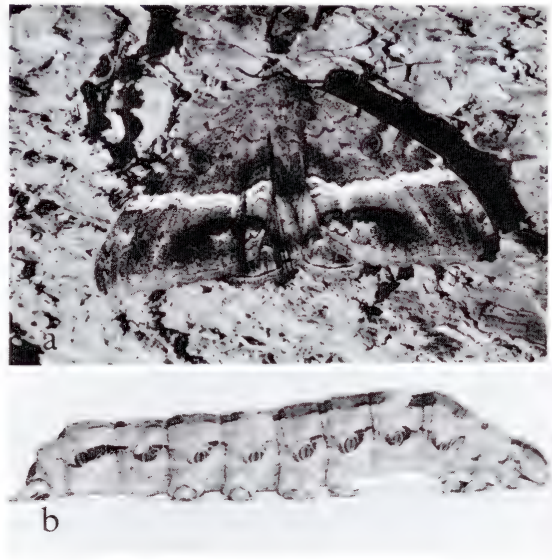


Figure 91. Black Witch: a.—adult male, b.—larva.

Because of its great size (wing span 6-7 inches), this moth might be mistaken for a member of the giant silk moth family. However, it is merely a giant of the cutworm or owlet moth family related most closely to the species following.

Its caterpillars will not be found in the Basin although the moth appears occasionally in the late summer or fall around lights. The species is not a proven resident of the continental United States, although abortive generations may occur in our area on ornamental acacias. The Black Witch is actually a tropical insect, very common in Mexico, Central America, and northern South America. It habitually migrates northward, however, when warmer weather prevails. Specimens, usually in a worn condition, have even been taken in the extreme northern states and Canada. At home in the tropics, the caterpillars feed on acacias and cassias.

NOTE: This species was known as *Erebus odora* in earlier literature.

REFERENCES: Comstock, J. 1936. Notes on the early stages of *Erebus odora* L. (Lepidopt.). Southern Calif. Acad. Sci., Bull., vol. 35, pp. 95-98.
Sala, F. 1959. Possible migration tendencies of *Erebus odora* and other similar species. Lepidopterists' Society, J., vol. 13, pp. 65-66.

Irene Underwing
(*Catocala irene*)

Figure 92. Irene Underwing.

Underwing moths, so named because of the brilliant red or orange hind wings, are rare in our area compared to the eastern United States. This species has scarlet hind wings which it hides at rest with fore wings marked precisely like rough tree bark. It usually is seen only when it comes to light or when accidentally alarmed during the daytime when the flashing color of the hind wings attracts the eye.

The larva is brown and feeds on willow.

Moon Umber
(*Zale lunata*)

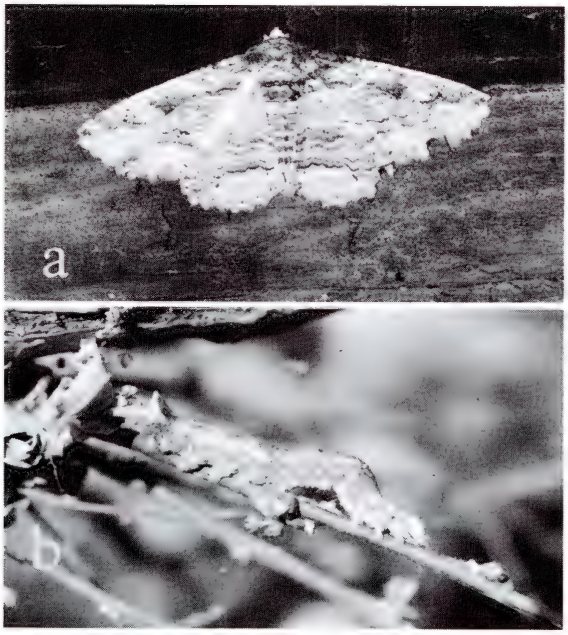


Figure 93. Moon Umber: a.—adult, b.—larva.

The adult of this species is variable; the most common form is shown in the figure. The larva, which resembles the preceding species, feeds primarily on willow but also oak, elm and other plants.

Palm Moth
(*Litoprosopus coachella*)

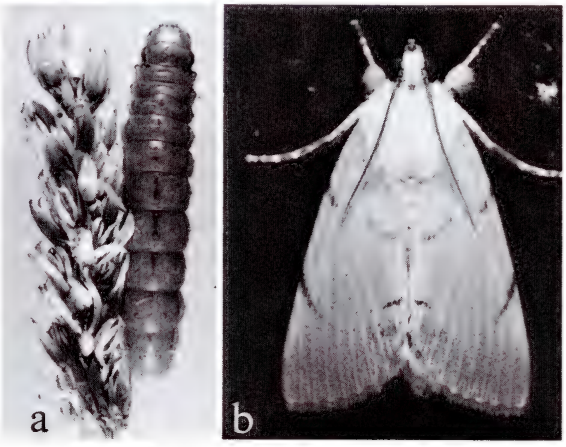


Figure 94. Palm Moth: a.—larva, b.—adult.

This moth is a common resident of Los Angeles because its food plants, the Fan Palms (*Washingtonia filifera* and *W. robusta*) are such widely grown parkway trees. The larva feeds on the reticulated fibers at the base of stems and on the flowers and fruits. The caterpillar sometimes makes itself a pest by entering homes in search of a site in which to spin its loose cocoon. It may also cut fabrics (curtains, clothing in storage) with its mandibles during its domestic wanderings.

The wings of the adult are entirely cream with a satin sheen. Their only conspicuous marks are twin, black OO's on the margin of the hind wings near the inner angle.

REFERENCE: Comstock, J. 1956. Is this a new, and giant clothes moth? S. Calif. Acad. Sci., Bull., vol. 55, pp. 51-53.

Tiger Moths

(Family Arctiidae)

Tiger Moths resemble owlet moths structurally, including the possession of a thoracic ear, but usually sport gaudy color patterns. The caterpillars

are typically covered with a dense growth of stiff hairs and are known popularly as "wooly bears." Usually the caterpillar incorporates some of these hairs into its cocoon which it spins above ground in some protected spot.

There are seven common species of tiger moths living in the Basin; the caterpillars of all but one of them are solid black or dark brown and indistinguishable except to the trained eye.

Acrea Moth
(*Estigmene acrea*)

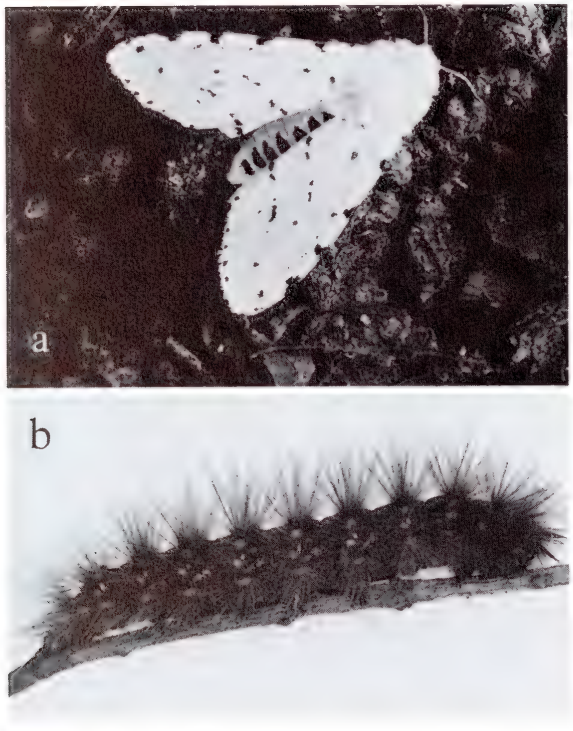


Figure 95. Acrea Moth: a.—adult, b.—larva.

The sexes differ in the color of the hind wings, being orange-yellow in the male, white in the female. The abdomens of both are orange-yellow with a median row of transverse black spots. This is probably the commonest tiger moth in the United States and locally, appearing during the summer. Its caterpillars, which will eat almost any plant, may at times be so numerous that they are considered pests. In the fall they may be even seen crossing highways in large numbers in agricultural districts. When mature they overwinter in plant debris. Pupation occurs in the spring in a loose grey cocoon constructed of silk and larval hairs. "Salt Marsh Caterpillar" is a name given to the larva because of its depredations to grasses in marshy areas on the Atlantic coast.

Vestal Tiger Moth
(*Maenas vestalis*)

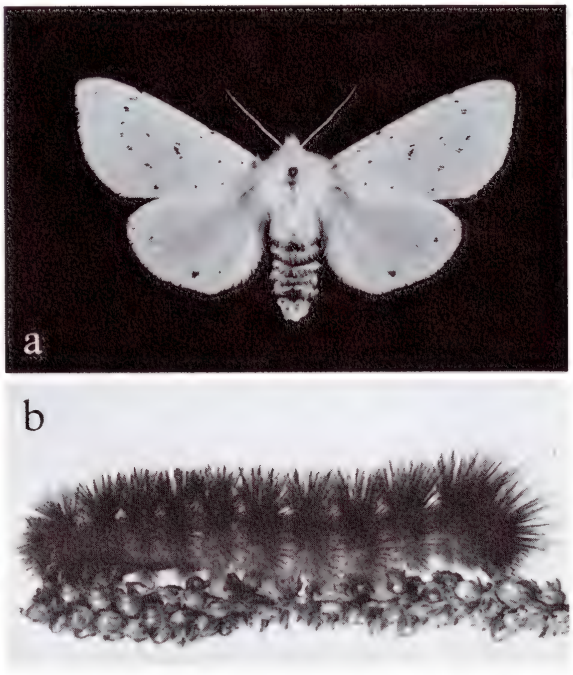


Figure 96. Vestal Tiger Moth: a.—adult, b.—larva.

This species is immediately recognizable by the conspicuous, red fore legs of the adult, which is otherwise pure white except for a few scattered black flecks on the wings. The adult flies during the spring and is not uncommon at lights. The larva feeds on a great variety of plants.

Painted Arachnis
(*Arachnis picta*)

The wings of this species are distinctively marked with broad, wavy, gray lines over a white background on the fore wings, and over a red background on the hind wings. Adults may be seen many nights in late September to October resting by porch lights or on store fronts. The caterpillar is a general feeder on numerous herbaceous plants. It develops during the winter, then is dormant until late the following summer when it pupates.

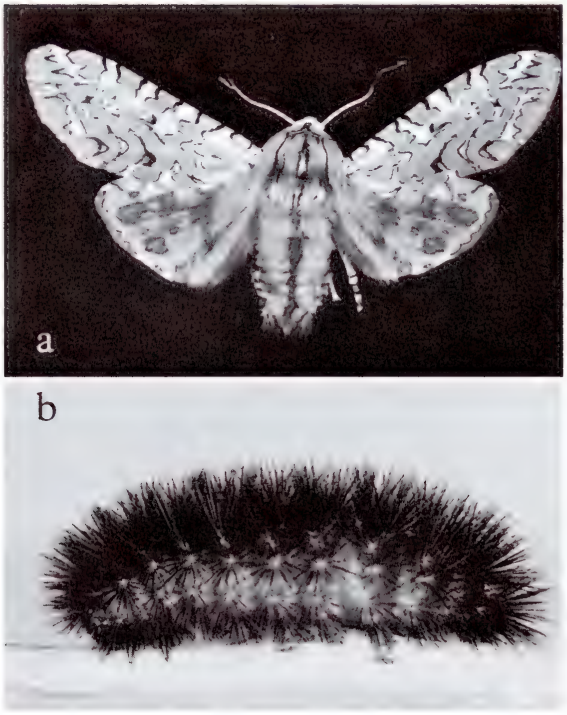


Figure 97. Painted Arachnis: a.–adult, b.–larva.

This tiger moth is most common in the canyons where its principal food plant, Coast Live Oak (*Quercus agrifolia*), grows. It is a fall flier. The larva, which has an immense, glossy brown head, hides in bark crevices during the day and crawls up the trunk to feed on the leaves after dark. Pupation occurs in the typical tiger moth cocoon of silk and larval hairs and is attached to the twigs and leaves of the host plant.

Edward's Glassy-wing
(*Hemihyalea edwardsii*)

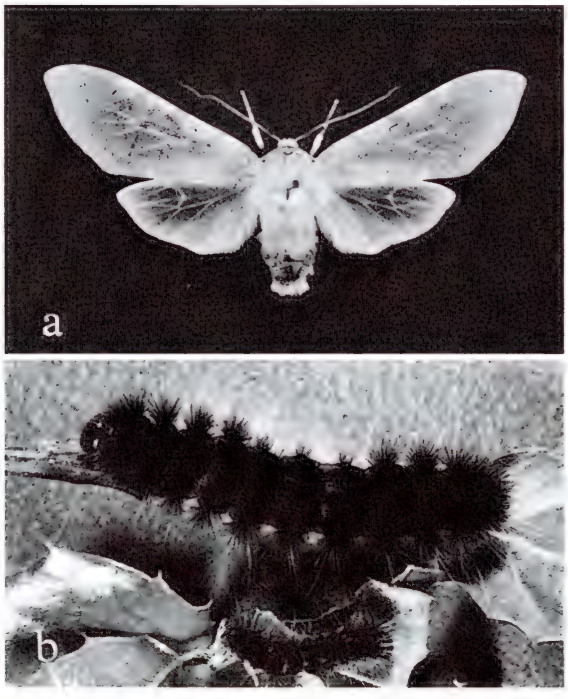


Figure 98. Edward's Glassy-wing: a.–adult, b.–larva.

Spotted Halisidota
(*Halisidota maculata*)

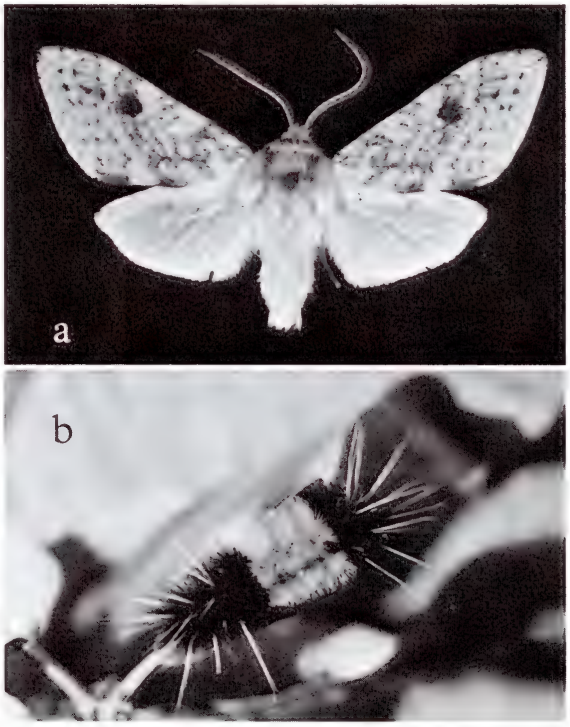


Figure 99. Spotted Halisidota: a.–adult, b.–larva.

This is one tiger moth which has a distinctive caterpillar. Though still classed as a wooly bear, it has a wide median belt of yellow and long tufts of white hairs front and rear. It may be very numerous on willows in the fall in some areas. The adults are generally yellowish brown in color with a slightly darker brown, marbled pattern on the forewings.

Mexican Tiger Moth
(*Apantesis proxima*)

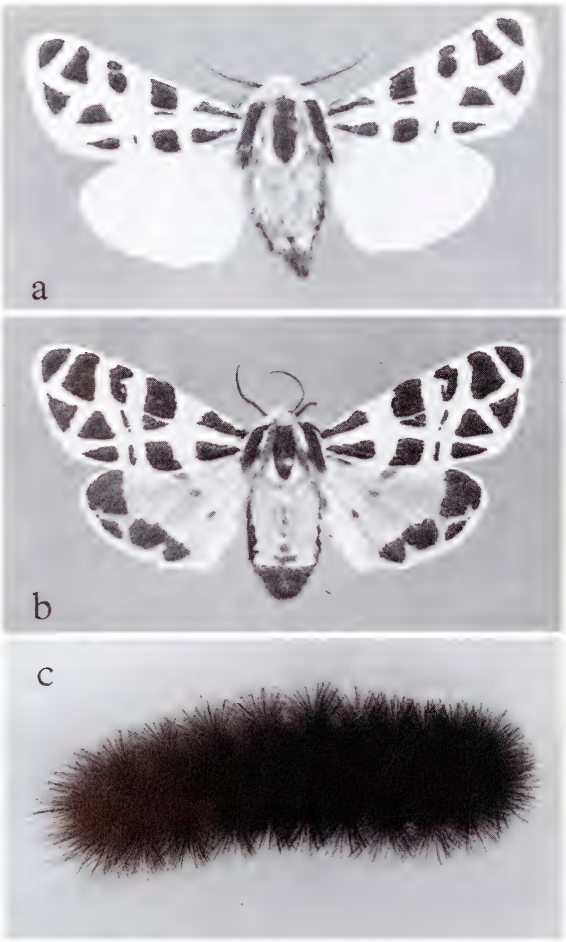


Figure 100. Mexican Tiger Moth: a.—adult male, b.—female, c.—larva.

The fore wings of this moth look like they have been criss-crossed with white lines so that only discrete triangles and squares of black color remain. The hind wings of the males are white; the females, red. Both sexes are often attracted to light during the summer. The larva is a general feeder on herbaceous plants.

Ornate Tiger Moth
(*Apantesis ornata*).

This variable moth is very similar to the preceding. However, both sexes have yellow (sometimes tinged with red) hind wings with a greater

Figure 101. Ornate Tiger Moth.

amount of black than the Mexican Tiger Moth. Also, the white bars of the fore wings are much narrower and the pattern of black polygons is more fragmented owing to additional fine streaks of white. The uncommon adult flies during late spring; males come to light in the very early morning, females are diurnal. The larva is a general feeder on low-growing, herbaceous plants.

NOTE: The local form has been considered as an aberration called "hewletti."

Oak Moths

Family Dioptidae

California Oak Moth
(*Phryganidia californica*)

Much of the decline of the Coast Live Oak in the Los Angeles area is attributable to the ravages of this species. The caterpillars, which have a conspicuous smooth brown or reddish head, are especially destructive in dry years when trees over large areas may be defoliated.

The pupae, are naked and shining whitish or yellowish with black streaks. They hang head-down like many butterfly chrysalids from the under surfaces of leaves, limbs, trunks of trees and nearby objects, often in large numbers.

The wings, which expand up to 1¼ inch, are uniform pale brown with darker veins; the males have a faint yellowish patch near the middle of the fore wing. Although development is more or less continuous throughout the year, the adults of a conspicuous spring brood are usually seen fluttering weakly around the host trees in June or July.

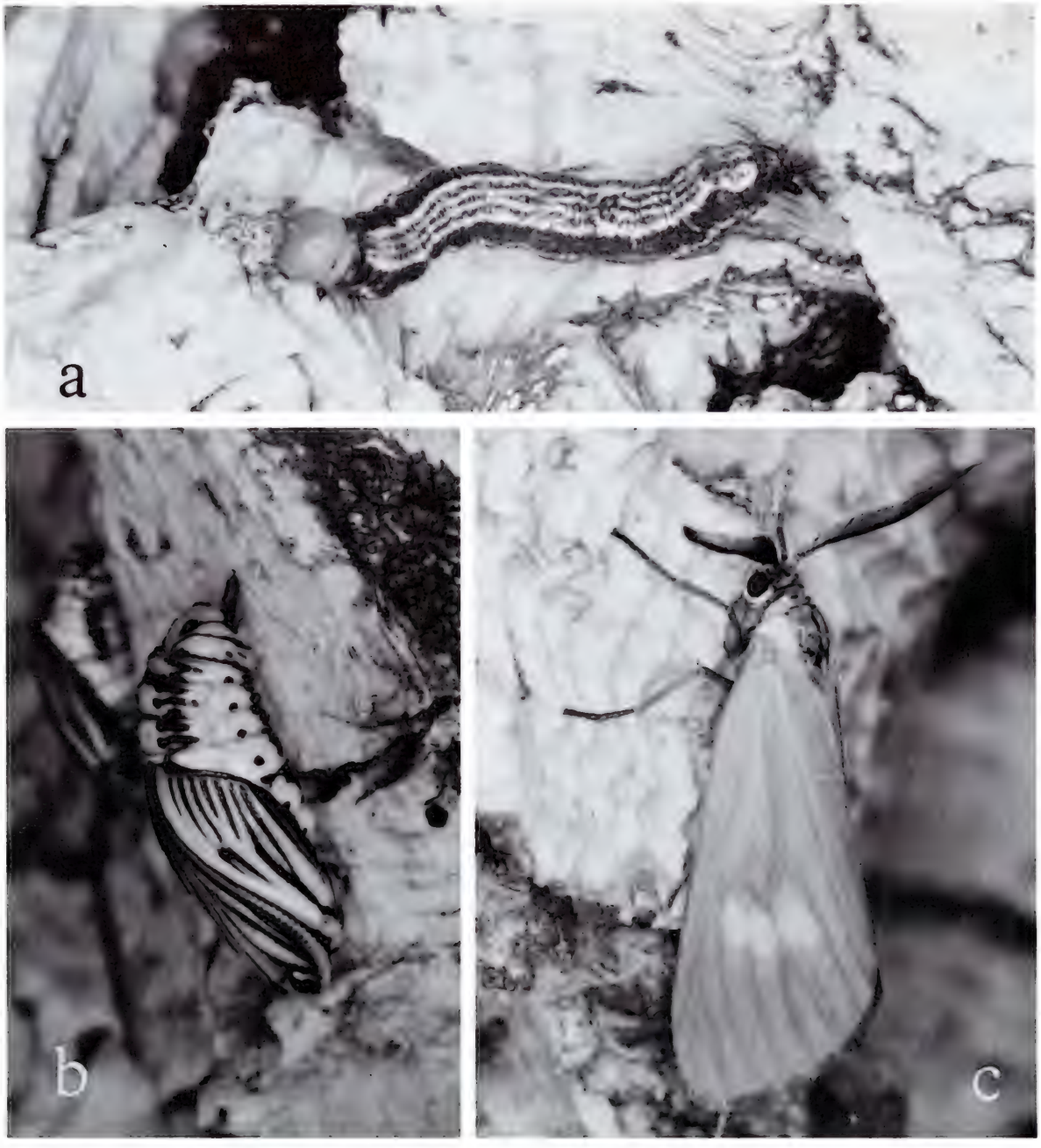


Figure 102. California Oak Moth: a.—larva, b.—pupa, c.—adult male.

REFERENCE: Brown, L. and C. Eads. 1965. California oak moth. Pages 44-47 *in* L. Brown and C. Eads. A technical study of insects affecting the oak tree in southern California. Calif. Agr. Exp. Sta., Bull. 810.

Measuring Worms

Family Geometridae

The common name of this family refers to the mode of locomotion employed by the caterpillars. Because of a lack of legs on the intermediate abdominal segments the larva can hold on to the substratum only with its thoracic legs at the anterior end of the body and two pair of prolegs at the posterior extreme. To advance, the rear set of legs is released and brought up behind the fore

set, the body arching up strongly (or looping) at the same time. Then the front set is released and the body stretched forward. In so doing, the caterpillar appears to be "inching" along, or measuring the extent of progress.

Adult measuring worms are usually drab colored moths somewhat resembling Owlet Moths. They differ consistently, however, in the possession of a pair of ears on either side of the first abdominal segment rather than on the thorax. Also, most species have more slender bodies than Noctuidae and rest with the wings either held together at the back or horizontal and flattened against the substratum and not roof-like as those moths do.

Of the approximately 100 local species, the following are the most conspicuous:

Omnivorous Looper
(*Sabulodes caberata*)

This is a prolific species breeding throughout most of the year on a wide variety of plants. The light colored caterpillars have irregular, broken, longitudinal marks and are common on English Ivy. They usually spin a loose webby shelter in a leaf fold or between two leaves in which to hide during the day; pupation takes place in a similar loose, white cocoon. Feeding activity goes on primarily at night.

With a wing span of approximately 1¾ inches the moths are generally light brown with darker speckles throughout the upper surface. A portion of the speckles are organized into two faint transverse lines across the wings. When the moth is at rest the wings are held out to the sides, the tips against the substratum.

The species is much more abundant in city gardens than in areas of native vegetation.

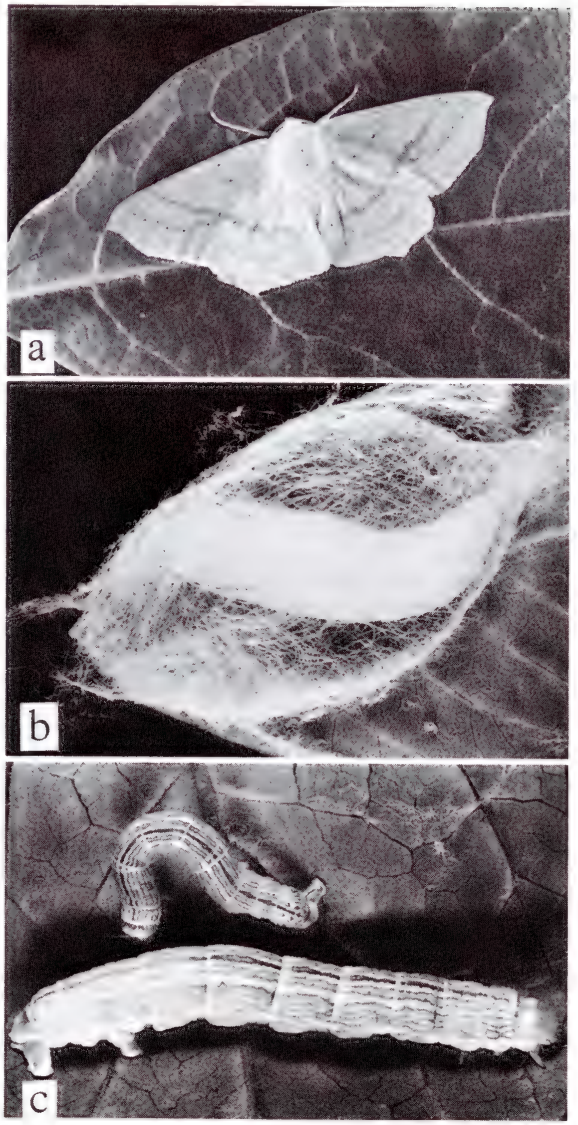


Figure 103. Omnivorous Looper: a.—adult, b.—pupa in cocoon, c.—larvae.

McDunnough's Pero
(*Pero macdunnoughi*)

This geometrid rests with its wings together over the back in butterfly fashion. It is nocturnal and has threadlike antennae, so there is no confusion as to its proper place among the moths. The larva is another general feeder on trees and shrubs but usually seems to be found on Red Berry Buckthorn (*Rhamnus crocea*), Flat Top (*Eriogonum fasciculatum*) and California Sage (*Artemesia californica*), among the native plants, and apricot and privet among the cultivated.

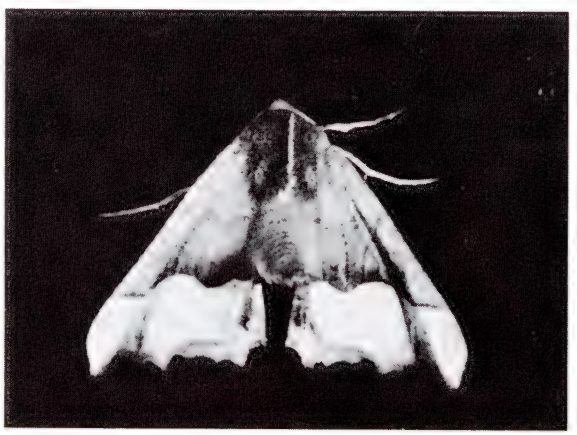


Figure 104. McDunnough's Pero.

Fragile Looper
(*Anacamptodes fragilaria*)

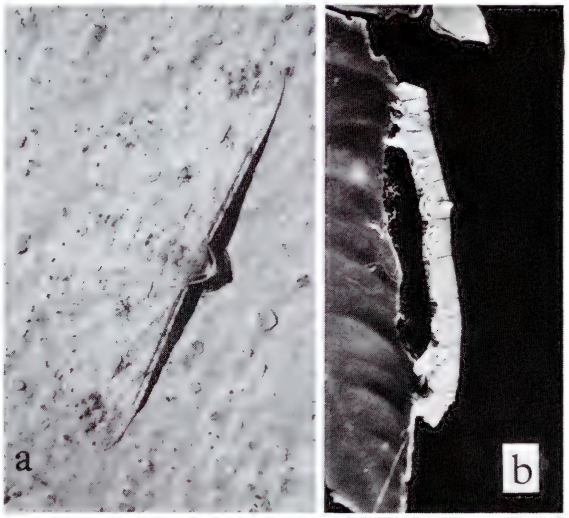


Figure 105. Fragile Looper: a.—adult, b.—larva.

A common resting place of this moth is on concrete and stucco walls, where its medium-grey, speckled wings nearly blend with the background. It flies during almost every month of the year but is commonest in summer and fall. Its caterpillar is a general feeder on trees and shrubs, but in the Basin it is most often found on acacia, lantana, Wild Lilac (*Ceanothus*) and Indian Tobacco (*Nicotiana glauca*).

REFERENCE: Comstock, J. and C. Dammers. 1946. Notes on the life history of *Anacamptodes* (*Cleora*) *fragilaria* Grossb. (Lepidoptera). So. Calif. Acad. Sci., Bull., vol. 45, pp. 17-20.

Tineid Moths

Family Tineidae

Webbing Clothes Moth
(*Tineola bisselliella*)

Of the several species of so-called clothes moths that do damage to fabrics, this is by far the most common. In nature, and doubtlessly before the advent of man, the clothes moth scavenged on all sorts of dry animal debris; fur, skin, feathers, horn, etc. In the home, clothes, carpets, rugs, upholstered furniture and other objects of animal origin are attacked. Usually, silk, paper, and other substances of plant origin are not eaten; neither are synthetic fabrics, such as nylon, unless they are woven in combination with wool.

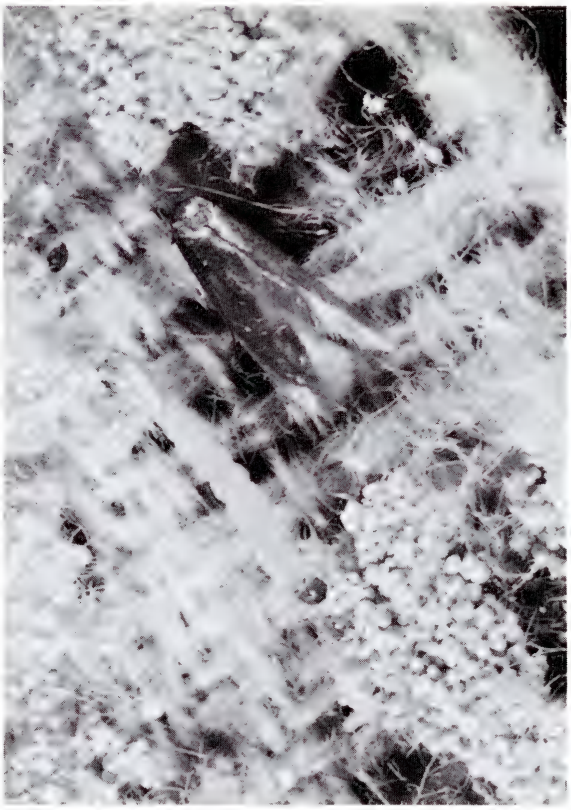


Figure 106. Webbing Clothes Moth.

It may be necessary to point out to some people that it is the larva and not the adult clothes moth that actually eats the fabric. The mouthparts of the adult would never permit it to chew such material, whereas the jaws of the caterpillar are ready-made for the purpose. The larva is tiny (less than ¼ inch long) and especially attracted by certain stains on wool; once it finds a suitable spot it settles down and feeds until a hole forms.

The adult Webbing Clothes Moth is also very small; at rest the length from the front of the head to the wing tips is only about ¼ inch. The moth is shiny white and has unmarked wings; its body is covered with brilliant scales and there is a fluff of reddish golden hair on the head.

Olethreutid Moths

Family Olethreutidae

Mexican Jumping Bean Moth
(*Laspeyresia saltitans*)

The larva of this moth supplies the "jump" in the Mexican Jumping Bean. These "beans," which are the seeds of the Arrowplant (*Sabestiana*

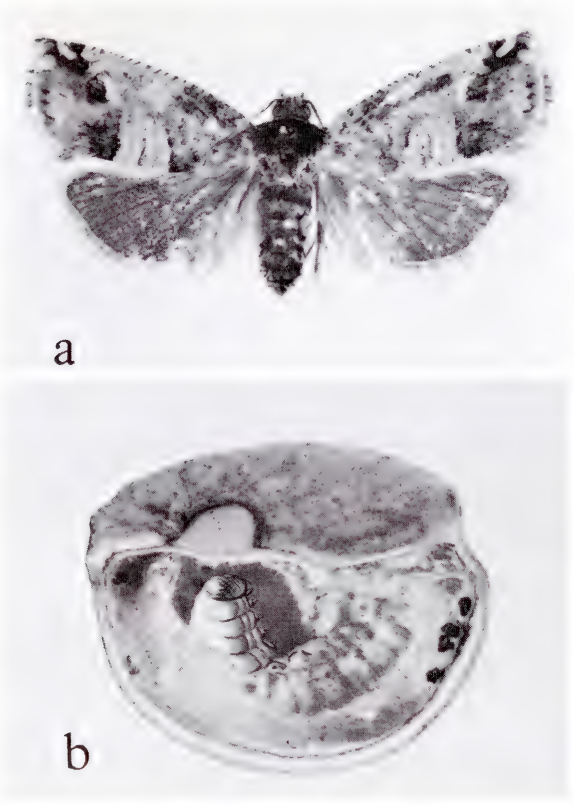


Figure 107. Mexican Jumping Bean Moth: a.—adult, b.—larva in bean (reconstructed).

pringlei), native to Mexico, are infested by the small, robust caterpillars. The latter frequently turn and jerk violently in their confined quarters, causing the bean to move. The action is enhanced by heating the beans, at which time they may actually jump into the air an inch or more. The larvae get inside the beans by eating their way into the young soft pods soon after they form at the base of the flower. The beans cease to jump when the larva dies or pupates.

The moth which emerges from the bean is small and mottled grey in color. It is a very close relative of the injurious Codling Moth (*Laspeyresia pomonella*), whose larva lives in apples and walnuts.

Jumping Beans, called "Brincadores" (jumpers) in Spanish, are imported in considerable numbers and sold as curiosities in a few places in the United States. They usually may be purchased on Olvera Street in Los Angeles when in season, June and July.

REFERENCE: Truxal, F. 1964. Los Brincadores (The Jumpers). Los Angeles County Museum, Quarterly, vol. 3, pp. 14-15.

Pyralid Moths

Family Pyralidae

Greater Wax Moth
(*Galleria mellonella*)

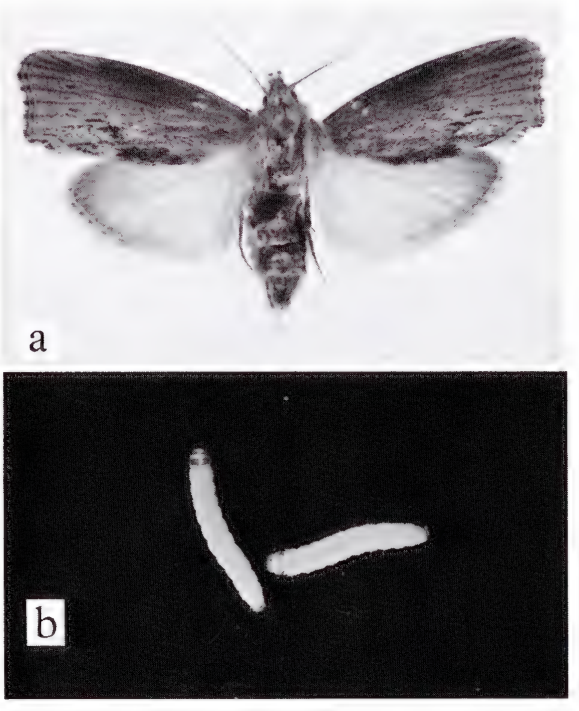


Figure 108. Greater Wax Moth. a.—adult, b.—larva.

The larva of this Wax Moth lives in Honey Bee hives, boring through the comb, feeding on pollen and waste materials in the cells and destroying young bees in the process. On account of this habit the insect is on the bee keeper's black list, although it usually occurs only in abandoned or weakened bee colonies.

When full grown, the larva creeps into a corner of the hive or other protected niche nearby and spins a tough white cocoon of silk mingled with its own dry fecal pellets.

The moth is medium-sized (wing span about 1 inch) and generally gray in color. It is usually never seen except by the apiculturist. However, it occasionally infests honeycombs made by wandering swarms which have settled in chimneys, attics or other nooks and crannies in houses. From this source, it sometimes strays indoors and makes itself a nuisance.

The species is not native. No doubt it was introduced from the Old World with its host.

REFERENCE: Wyndham, R. 1959. The curious ways of the wax moth. Nature Magazine, vol. 52, pp. 189-191.

Pantry Moths

Several species of small pyralid moths occur in the home. They originate in the kitchen where the larvae infest stored cereals, flour, corn, oatmeal, spices and other dry food products.

The most common local representatives of this group are the following:

Meal Moth
(*Pyralis farinalis*)

Figure 109. Meal Moth.

The adult's wings span about one inch. The fore wings bear a light brown zone in the middle bounded on both sides by darker brown; thin white lines separate the three color fields.

The larvae are dirty white except for the dark brown head and first thoracic segment. They live in cases or tunnels of silk mixed with food debris. Stale, damp material is preferred but all stored vegetable products are susceptible to their ravages.

Indian Meal Moth
(*Plodia interpunctella*)

The wing span of this species is only about 5/8 inch. The fore wings are divided into two color fields: a smaller basal silvery white or gray region and a larger outer bronzy region.

Only the head of the larva is pale yellowish brown; the rest of the body is white. It can be found upon an almost endless assortment of foodstuffs, always in a mass of silken webbing.

REFERENCE: Donohoe, H. 1937. Indian meal moth in California. J. Econ. Entomol., vol. 30, pp. 680-681.

Figure 110. Indian Meal Moth.

Mediterranean Flour Moth
(*Anagasta kuehniella*)

Figure 111. Mediterranean Flour Moth.

The larval habits and food preferences of this pantry moth are similar to those of the above species. Its body is pinkish or whitish except for the dark head, and it lives in silken tubes.

The adult wing span is slightly less than an inch. The fore wings are gray variegated with obscure wavy lines.

Incurvariid Moths

Family Incurvariidae

Yucca Moth
(*Tegeticula maculata*)

Figure 112. Yucca Moth, adult in yucca bloom.

This moth is well known to students of ecology for the part it plays in the pollination of the yucca plant. The only yucca occurring in our area is the Common Yucca or Quixote Plant (*Yucca whipplei*),the species with a large basal cluster of sharp tipped, narrow leaves from the center of which grows a tall flower stalk, and which is a conspicuous member of the coastal sage plant association.

In the early spring the Yucca Moth is attracted to the flowers of this plant. Females lay their eggs in the ovary of the flower where the seeds will later develop. The caterpillars, upon emerging from these eggs, feed on some of the seeds of each pod. The remaining seeds mature normally, the flower having been carefully pollinated by the female at the time of her egg-laying visit. The females even have mouth part structures especially modified to facilitate the gathering and transport of pollen. This moth-yucca relationship constitutes a case of symbiosis wherein both species benefit by way of their complementary needs. Furthermore, the relationship is obligatory, the plant being unable, or rarely able, to pollinate itself by other means.

The moths are small (wing span ¾-⅞ inch) with elongate, pure white fore wings and apical black markings. They may be attracted commonly on spring nights to lights in the proximity of flowering yuccas. The larvae burrow into the soil at the base of the plant to pupate.

The larvae of the Bogus Yucca Moths (*Prodoxus* species) live in the bases of yucca seed capsules, not in the seeds, and play no part in the plant's pollination. Because of their similarity and proximity to true Yucca Moths they are often confused with them. To pupate, the lavae burrow into the yucca stalk rather than into the ground.

REFERENCE: Powell, J. and R. Mackie. 1966. Biological interrelationships of moths and *Yucca whipplei*. Univ. Calif., Pub. Entomol., vol. 42, pp. 1-59.

Clear-winged Moths

Family Aegeriidae

Hornet Moth
(*Paranthrene robiniae*)

Figure 113. Hornet Moth: adult (right), empty pupal case protruding from willow branch at left.

This moth is a near perfect mimic of a wasp; there seems to be no question that the species derives strong protection by resembling wasps of the genus *Polistes* in form, color and behavior. The larva burrows in the wood of poplar and willow.

Plume Moths

Family Pterophoridae

Moths of this family frequently arouse the curiosity of local citizens who do not recognize them as moths. At rest they hold their slender, rolled up wings at right angles to the body and form the configuration of a crucifix. Plume moths get their name from the wings, which are divided in a fanlike fashion; each forewing is notched at the end, while the hindwings are deeply incised into three paddle-shaped lobes. They are further characterized by their long, slender legs.

Several species and genera occur locally. They are all small, the largest not exceeding ¾ inch in body length.

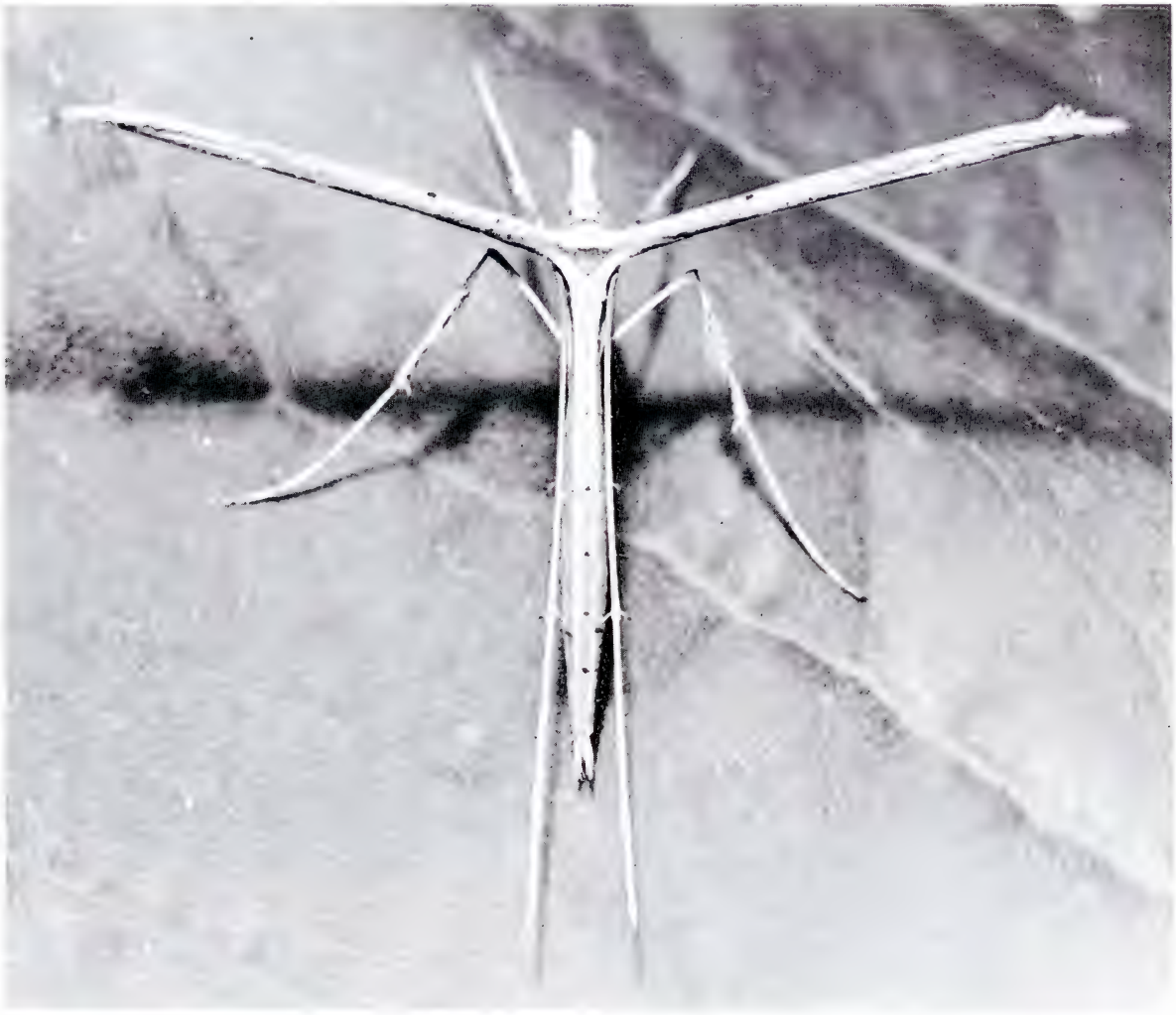


Figure 114. Plume moth.

Butterflies

Along with birds and flowers, butterflies have always been conspicuously appreciated by lovers of natural beauty. Even in ancient history butterflies and their metamorphoses were known and admired, so it is not surprising that they were adopted as the symbol of the soul, Psyche, in Greek poetry. In classic art, Psyche, the wife of Cupid, is usually represented as a girl with butterfly's wings.

REFERENCE: Emmel, T. and J. Emmel. 1973. The butterflies of southern California. Nat. Hist. Mus. Los Angeles County, Sci. Ser. 26.

Swallowtail Butterflies
Family Papilionidae

Western Tiger Swallowtail
(*Papilio rutulus*)

This large species, with its brilliant yellow wings crossed by black stripes, is one of our most conspicuous butterflies. (A similar relative, the Pale Swallowtail—*Papilio eurymedon*—might be confused with it but for the white rather than yellow wing color.) although more prevalent in riparian situations in rural and wild areas, it is not uncommon in urban and suburban residential districts.

Mature caterpillars are all green except for two "eye" spots on the back of the swollen thorax and

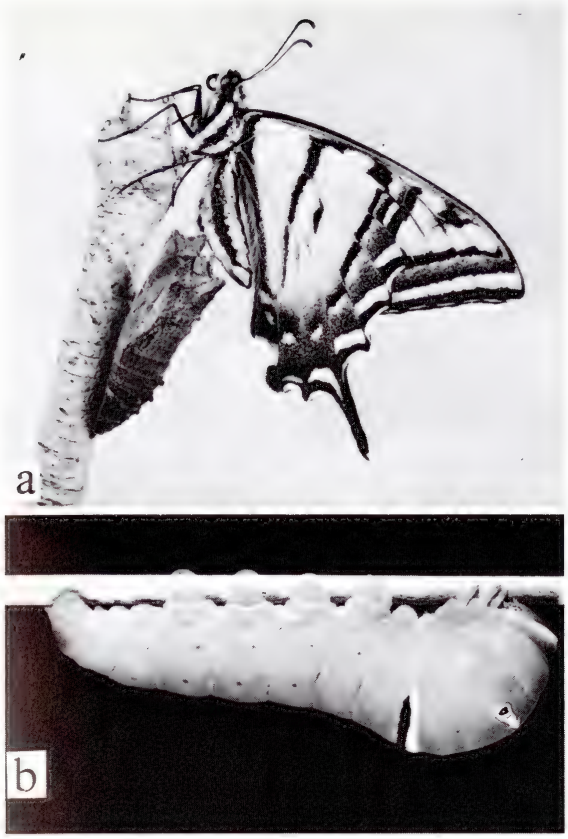


Figure 115. Western Tiger Swallowtail: a.—adult, freshly emerged from pupa, b.—larva.

a transverse, black margined yellow band a short distance behind on the tapering abdomen. The principal local larval food plants are poplar, willow, sycamore and alder (*Alnus*).

Anise Swallowtail
(*Papilio zelicaon*)

This species is not as common in the Basin nowadays as it was in the past, probably because of the relative scarcity of its principal food plant, Sweet Fennel (*Foeniculum vulgare*) a tall, licorice-flavored weed erroneously called Anise because of its similarity to that commercial species. Garden grown parsley and carrot tops also serve as hosts.

The caterpillar, when full grown, is predominantly green with black stripes, interrupted by orange spots. When disturbed it rears up and two orange colored, fleshly horns appear behind the head. These structures produce a strong odor which presumably protects the larva from predators.

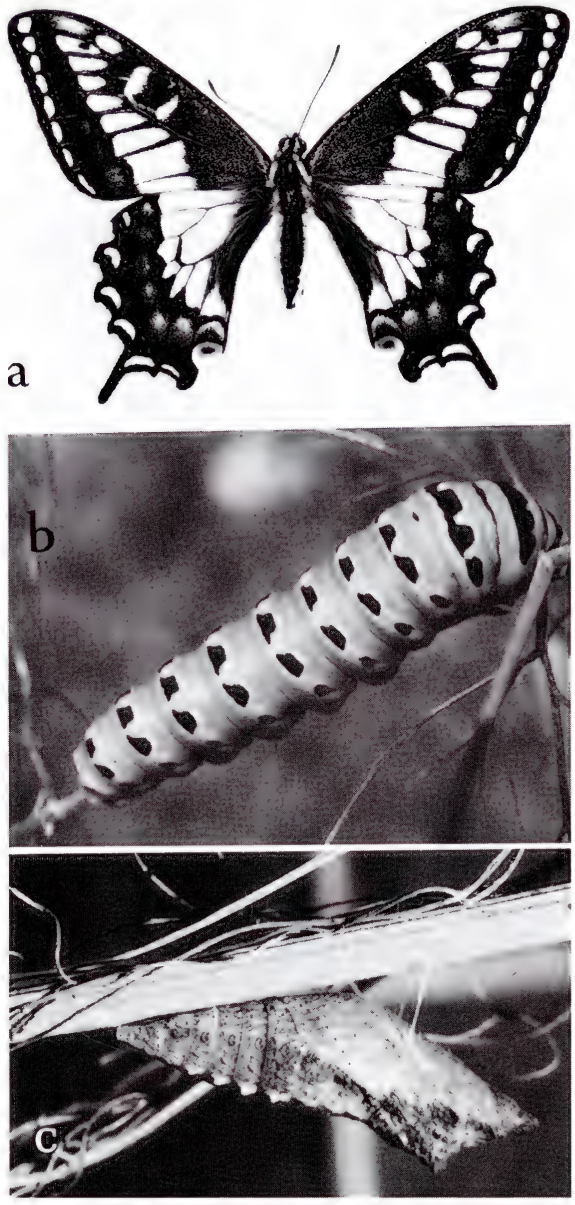


Figure 116. Anise Swallowtail: a.—adult, b.—larva, c.—pupa.

The chrysalis is typical of the swallowtail group of butterflies, resting in an upright position. It is attached at the tail end by a button of silk and supported around the middle by a threadlike girdle, an arrangement suggesting the window washer standing on a building ledge and leaning back on his safety belt. There are brown, gray, and green forms of the chrysalis. The color usually matches that of the substratum: brown and gray on wood, tree trunks, etc., green on the living plant.

Brush-footed Butterflies

Family Nymphalidae

Monarch
(*Danaus plexippus*)

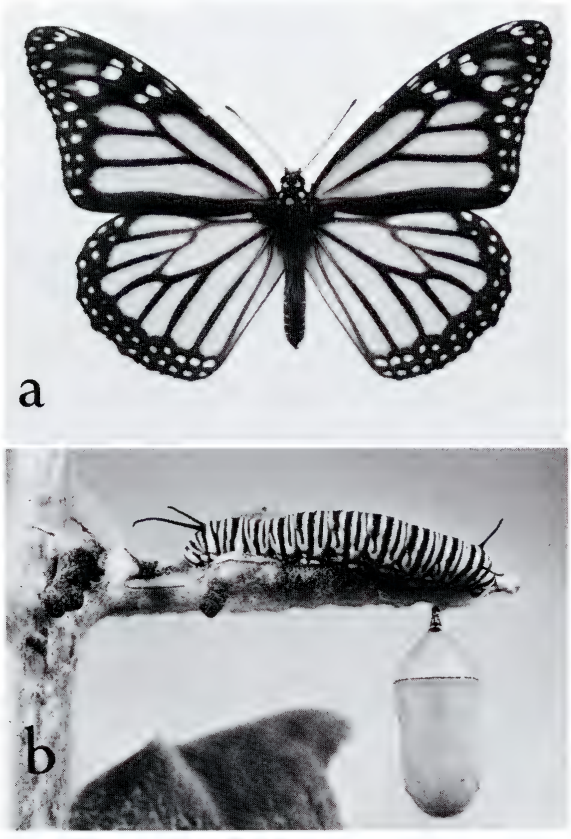


Figure 117. Monarch: a.—adult female, b.—larva and pupa.

The Monarch Butterfly is probably our most widely known insect. Conspicuous and easily recognized by its large size and handsome, black streaked, orange wings, its name is part of the vocabulary of nearly all those who have thought even fleetingly of butterflies.

A large, black, oval spot on the second vein from the inner margin of the hind wing distinguishes the male Monarch from the female. The spot is actually a pouchlike structure (usually called the "scent gland") whose complete function is not known. It is undoubtedly involved with courtship behavior. Probably the male inserts a quantity of female stimulating fluid (secreted by special glands located at the tip of the abdomen) into these pouches from which it diffuses later during the mating process.

Female Monarchs lay heir eggs only on the various species of Milkweed (*Asclepias*), the leaves of which form the exclusive diet of the caterpillar. The latter sport a zebra style pattern of alternating bands of black and light yellow. A pair of long fleshy filaments project from the second body segment behind the head, a shorter pair from near the rear. Larval development requires 10-20 days.

The chrysalis is a beautiful object, waxy jade green with brilliant gold spots, and dubbed "the little green house with the golden nails," by one poetic entomologist.

Many biology textbooks describe the Monarch's distastefulness which protects it from being eaten by vertebrate predators and which forms the basis for resemblance by the Viceroy Butterfly (*Limenitis archippus*) in other parts of North America. The Monarch is also famous for its yearly migrations. Each summer and fall large numbers emigrate from the northern breeding grounds to overwintering areas in the southern United States and Mexico. The distance covered by individuals may be remarkable. One tagged specimen, released in Ontario, Canada was recovered 1870 miles to the south in San Luis Potosi, Mexico.

In the overwintering zone the butterflies may form nightly roosting aggregations in large trees. Groves of these so called "butterfly trees" are found all along the southwest coast from Ensenada, Baja California to Monterey, among them the famous Butterfly Park in Pacific Grove where a city ordinance provides for the protection of the Monarchs during their annual stay in the local Monterey Pines and eucalyptus trees. The butterflies usually begin arriving in the city in October and stay until March, when the return migration begins. Individuals fly leisurely northward, breeding along the way, with the offspring of the transient generations continuing the flight.

The advantage of this migration to the Monarch is obvious—the species escapes the harsh northern winter. The factors which start them and guide them on their journey are not so obvious and are still grouped under the vaguely defined term "instinct."

REFERENCE: Urquhart, F. 1960. The Monarch Butterfly. Univ. Toronto Press, Toronto.

Gulf Fritillary
(*Agraulis vanillae*)

The metallic silver spots on the under surface of the wings immediately identify this species. Its

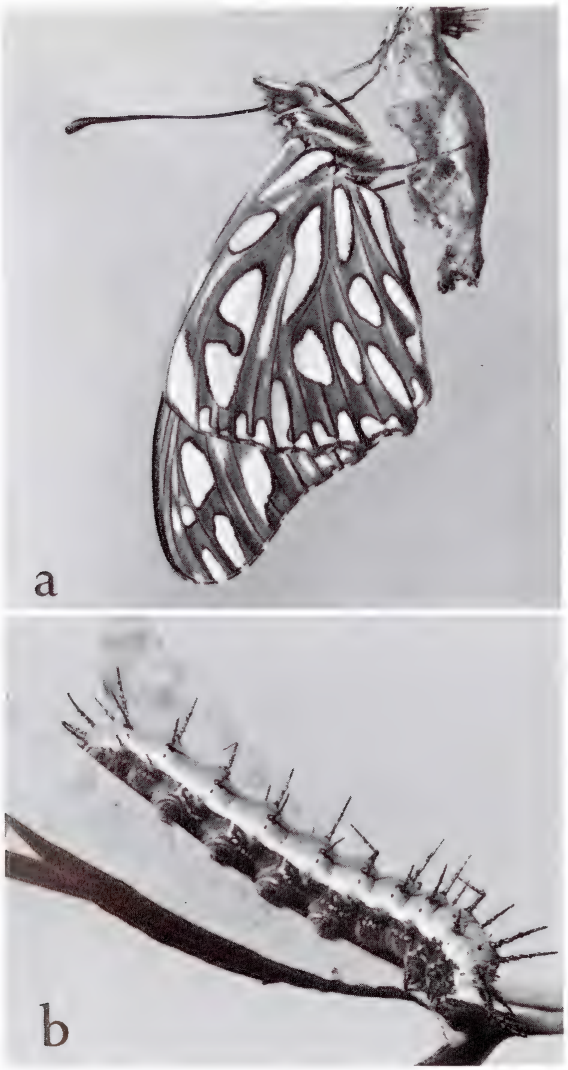


Figure 118. Gulf Fritillary: a.—newly emerged adult, under surface, b.—larva.

presence is a sure sign that a Passion Flower vine (*Passiflora*) grows in a neighborhood yard. The caterpillars are entirely partial to this vine which is native to Latin America and where it is a popular garden ornamental. The butterfly undoubtedly followed the plant to California when the latter was brought in by the early Mexican immigrants. The adults seldom wander far from the plant and may fairly swarm around it on warm summer days.

The mature caterpillar is spined and colored slate gray or purplish on the back with burnt orange stripes along the sides. The mottled gray chrysalis hangs from almost any horizontal object near the food plant, commonly the wires and braces of a chain-link fence through which the vine is growing. In its color and form it closely resembles a dry, curled leaf.

Painted Lady
(*Cynthia cardui*)

Figure 119. Painted Lady.

This species has the widest distribution of any butterfly in the world and is migratory like the Monarch. Its migration routes and frequencies, however, are not as well defined nor as well studied. Mass flights of this species though the Los Angeles area have occurred fairly often. The last heavy flight took place in the winter and spring of 1958 when tens of thousands of Painted Ladies passed through the Basin in a north-westerly direction. The place of origin of these numbers is not known exactly; they probably develop during wet years in northern Mexico.

The spiny caterpillars locally feed on Cheeseweed (*Malva parviflora*), a common weed of vacant lots, and hollyhocks. They are usually found nestled under a loose silk web in the cupped leaves of these plants. Until totally consumed, this leaf receptacle forms a place of abode for the larva. Thistles and nettles are hosts in other areas.

The illustration provided will permit distinction of this species from the two following which are close relatives of the Painted Lady, and which resemble it quite closely.

NOTE: This, and the next two species, have formerly been placed under the generic name *Vanessa*.

REFERENCES: Abbott, C. 1962. A migration problem—*Vanessa cardui* (Nymphalidae), the painted lady butterfly. Lepidopterists' Soc., J., vol. 16, pp. 229-233.

Tilden, J. 1962. General characteristics of the movement of *Vanessa cardui* (L.) J. Res. Lepidoptera, vol. 1, pp. 43-49.

West Coast Lady
(*Cynthia annabella*)

Figure 120. West Coast Lady.

This species is more a resident of our area than the preceding and much more common except in the migratory years of the Painted Lady. The feisty adults find vacant lots a favorite haunt but may be encountered almost anywhere. The species sometimes migrates. The caterpillar closely resembles that of the Painted Lady and feeds on similar plants.

Virginia Lady
(*Cynthia virginiensis*)

Figure 121. Virginia Lady.

The third member of the "painted lady group" is perhaps the most distinctive with its two oversized eyespots on the underside of the hind wing. Its distribution is the most limited and it is scarce in the Basin compared to either of the two preceding species.

The structure and food preferences of the immature stages are similar to those of its two close relatives.

Red Admiral
(*Vanessa atalanta*)

Figure 122. Red Admiral.

The wings of this butterfly are mostly black; a vivid red band runs diagonally across the fore wing and the hind wing has a similarly colored hind border. The pattern, which is suggestive of the alderman costume used in the British Isles during early times, led Comstock to propose the name Alderman butterfly for this species.

Its caterpillars feed on the leaves of Nettle (*Urtica*) and Pellitory (*Parietaria*) in the foothills; among these plants they hide themselves in leaves which they roll about themselves and seal with silk; in this leafy bower the pupa may also be concealed. In the city they feed on the common ground cover, Baby's Tears (*Soleirolia*).

Mourning Cloak
(*Nymphalis antiopa*)

The Mourning Cloak is rather common in the Basin, even in metropolitan areas, because its larval food plants are popular ornamental trees: elm, willow, and poplar.

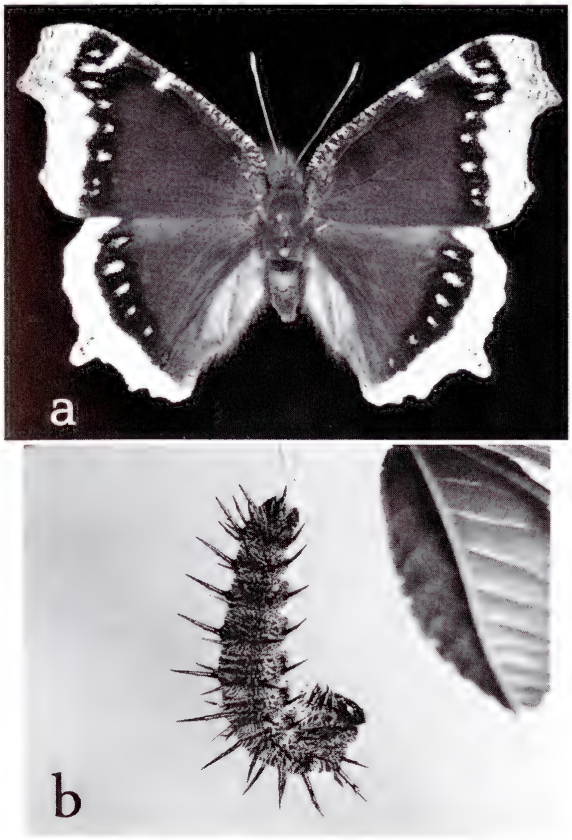


Figure 123. Mourning Cloak: a.—adult, b.—larva, preparing to pupate.

The caterpillars are black with long spines; a row of dull brick-red spots runs down the back. The larvae live in communal webs until mature, when they leave the nest in search of a pupation site. At this time they often attract attention as they cross sidewalks and driveways. Eves, window sills and porch ceilings commonly fill the caterpillar's needs. I have seen houses with the gray chrysalids hanging so profusely from such locations that they suggest Christmas tree decorations.

Mourning Cloaks are inquisitive creatures. They are attracted to unlikely resting places, such as lawn furniture, and will even perch on a person if he stands perfectly still. I have amazed onlookers on more than one occasion by holding my hand out in the direction of a circling specimen and having it promptly land on a finger.

This is one of the few butterflies that overwinters as an adult. It may be found on cold winter days nestled in the crevices of tree bark or in other protected places. Their torpor is not deep, however, and they will venture forth to enjoy a flight and take some nectar should a warm day come along.

Buckeye
(*Precis coenia*)

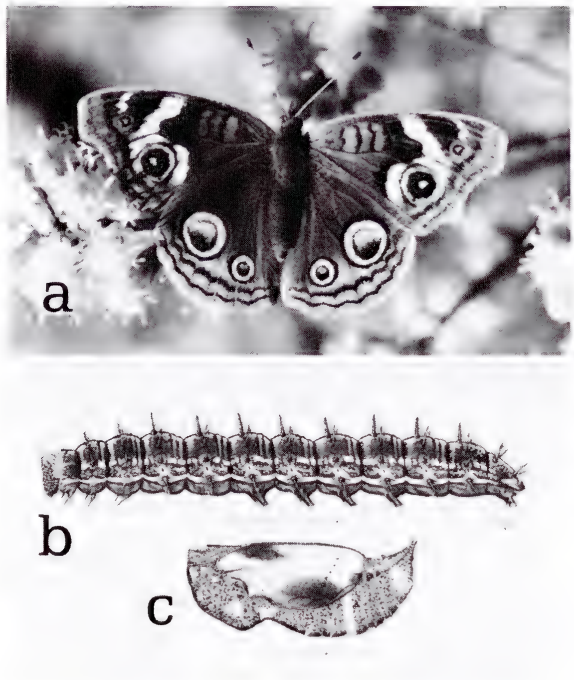


Figure 124. Buckeye: a.—adult, b.—larva, c.—pupa.

The large eye spots on the upper surfaces of the wings immediately identify this species. It belongs to a primarily tropical group called Peacock Butterflies, so named because these eye spots resemble the pattern on the tips of Peacock Bird feathers.

Buckeyes display a fighting bent when other butterflies come too close. The intruder is submitted to a series of forceful, rapid wing blows which usually quickly discourage it.

Two forward pointing horns on the head distinguish the caterpillar from similar spined forms. It feeds on the leaves of a variety of plants; locally the commonest are snapdragons and Plantain (*Plantago*), a common lawn weed.

Chalcedon Checker-spot
(*Euphydryas chalcedona*)

Though rarely seen in the floor of the Basin, this extremely variable species may be quite numerous in the surrounding foothills, visiting flowers in the spring and early summer. The larvae feed on a variety of plants of the Figwort family (Scrophulariaceae), but locally they are particularly

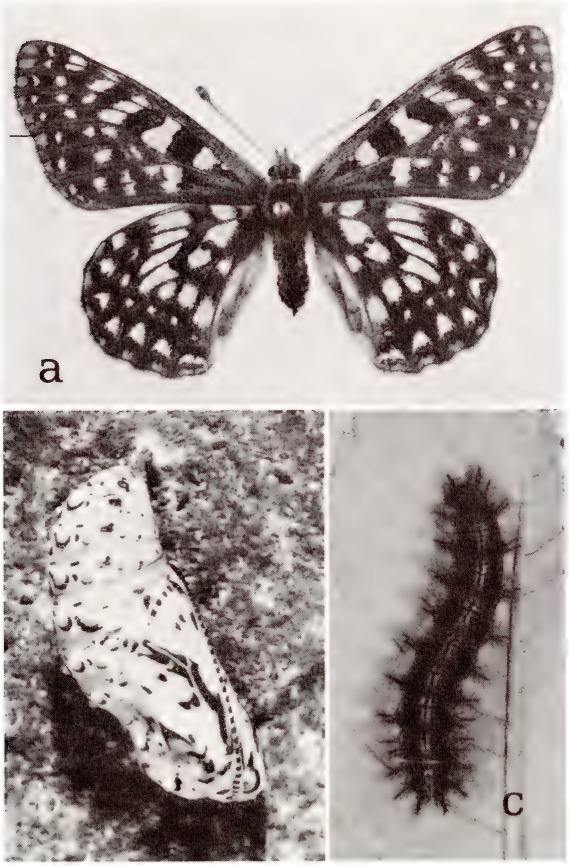


Figure 125. Chalcedon Checker-spot: a.—adult, b.—pupa, c.—larva.

fond of Sticky Monkey Flower (*Diplacus longiflorus*), a common native shrub. The chrysalid is generally light with a colorful pattern of orange, red and black spots and bars.

California Sister
(*Limenitis bredowii*)

A beautifully marked species with a white median band and large orange apical spot on the fore wing, Comstock, in his book *Butterflies of California*, describes the California Sister as "a regal butterfly, of dignified demeanor and exclusive habits. It spends much of its time in solitary flight about the upper branches of the live-oaks, or perched on high vantage points where it can survey the woodland life below."

The butterfly is most common during the summer in the canyons of the San Gabriels, their foothills and the Santa Monica mountains, wherever the Canyon Oak (*Quercus chrysolepis*) grows.

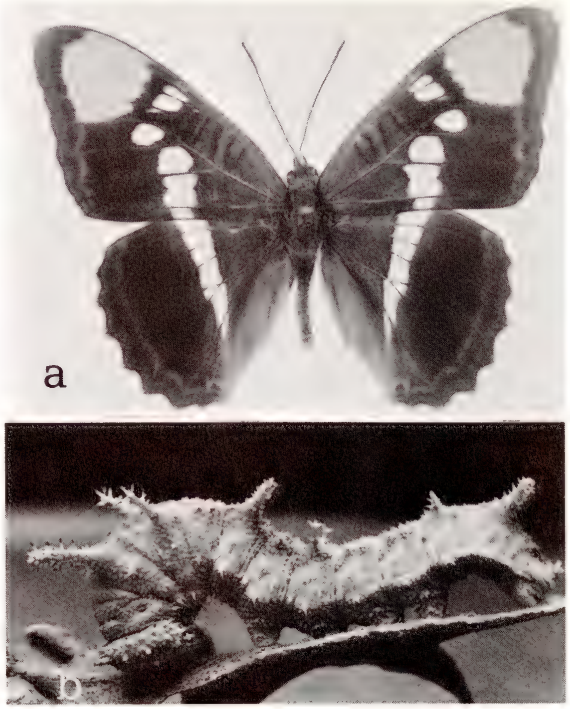


Figure 126. California Sister: a.—adult, b.—larva.

The caterpillars, which are light green with brownish mottling and with hornlike projections on the head and third body segment, feed on the leaves of this and related live oaks.

Lorquin's Admiral
(*Limenitis lorquini*)

This butterfly is easily mistaken for the California Sister, being generally similar in basic color pattern, size and habitat, but it has orange bars along the apices of the fore wings rather than large round orange spots. Other differences are evident in the illustrations of these two species.

Again, it is appropriate to quote Comstock, for he aptly describes this Admiral's habits as follows, "It frequents water courses and moist wooded areas, being especially abundant in river bottomlands that are overgrown with willow [the larval food plant]. The flight of this boldly marked butterfly is characterized by a series of short twitching motions, with the wings held nearly flat, interspersed with leisurely volplaning."

The species once occurred in the Baldwin Hills but is probably extinct there now due to the destruction of its habitat by Progress. The canyons

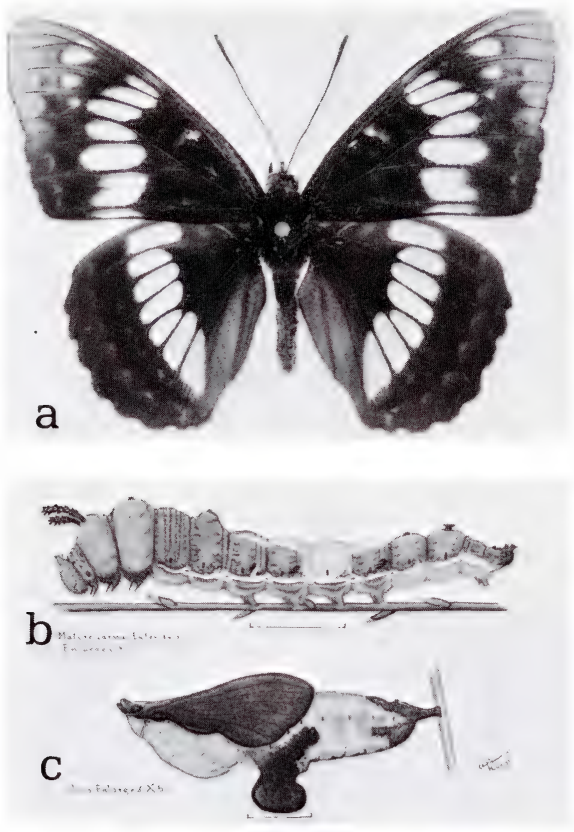


Figure 127. Lorquin's Admiral: a.—adult, b.—larva, c.—pupa.

of the San Gabriel and Santa Monica mountains are now its principal refuge in our area.

California Ringlet
(*Coenonympha california*)

Figure 128. California Ringlet.

This delicate, creamy-white butterfly is a precocious member of the Oak Woodland fauna, appearing, sometimes in abundance, in the early days of spring. Its feeble halting flight and small size easily separate it from the "Whites."

The larva is long and slender, matching in shades of brown and green the grasses upon which it feeds.

Whites and Sulfurs

Family Pieridae

European Cabbage Butterfly
(*Pieris rapae*)

This butterfly is one of our commonest, although it is not a native species. It was accidentally introduced into Quebec from Europe around 1860 and quickly spread throughout the United States. The caterpillars, which are pale green and somewhat

Figure 129. European Cabbage Butterfly: a.—adult, b.—pupa, c.—larva.

wormlike in form, feed on various plants of the mustard family, especially cabbage. Their appetite for this vegetable is so great that they consume thousands of dollars worth yearly. Locally, however, the principal food plants are probably weeds, such as Wild Mustard (*Brassica campestris*) and Wild Radish (*Raphanus sativus*). They are also to be found in the garden on Nasturtiums.

Common White
(*Pieris protodice*)

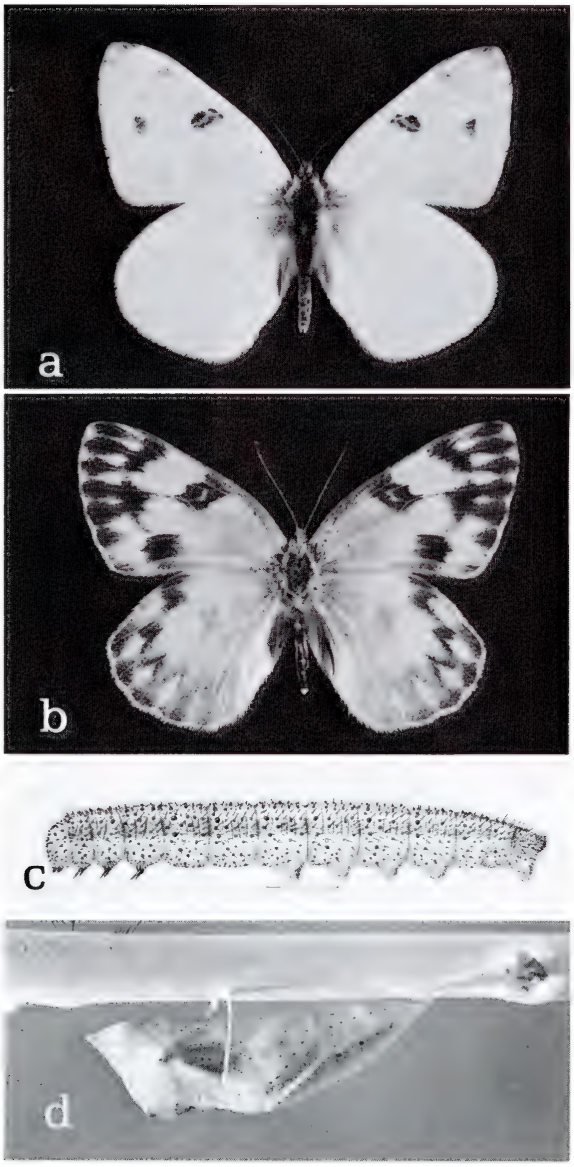


Figure 130. Common White: a.—adult male, b.—female, c.—larva, d.—pupa.

This butterfly could only be confused with the European Cabbage White in flight; at rest, its checkered pattern of black spots immediately distinguishes it. There is some sexual dimorphism: the males lack dark markings on the hind wings and are only moderately maculate; the females are extensively marked on the upper surfaces of both pairs of wings.

The caterpillar is variable in color from deep to pale bluish to green. It has four yellow lengthwise stripes and is thickly covered with black dots. Its food plants consist of a wide variety of crucifers, especially wild mustard in our area.

Nicippe Yellow
(*Eurema nicippe*)

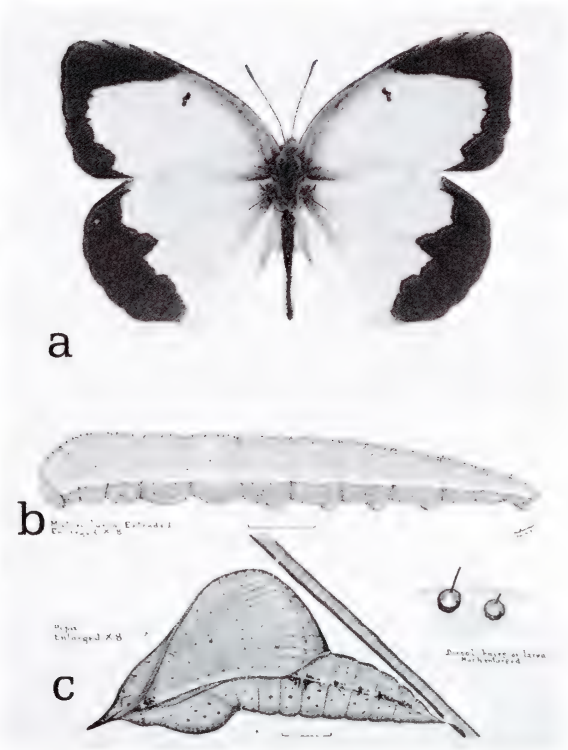


Figure 131. Nicippe Yellow: a.—adult, b.—larva, c.—pupa.

Deep orange wings with broad black borders immediately set apart this species. There is also a small transverse spot, which, with a bit of the same imagination needed to see the "face" in the Dogface Butterfly, looks like a half-closed eye and has given it the name "Sleepy Yellow."

It is essentially a tropical butterfly which has spread northward into our area, its caterpillars normally feeding on the exotic sennas (*Cassia*). Other legumes, such as clover, act as secondary host plants.

California Dog-face
(*Colias eurydice*)

Figure 132. California Dog-face, male.

The illustration provided here will aid those people who have difficulty seeing the dog's face in the fore wing of the male. Within the black border the wing gives off a singular purplish iridescence which changes in intensity depending on the angle from which it is viewed. The outline of the wings and contrasting gaudy colors of the fore and hind wings simulate the pansy flower in the minds of some observers who have nicknamed the butterfly "Flying Pansy." The females are pure sulfur yellow except for a round dark spot near the center of the leading edge of the fore wing.

Though normally a mountain species it occasionally strays into the hilly northern areas of the Basin. The caterpillars feed on the leaves of the False Indigo Plant (*Amorpha californica*).

In 1972, the California Legislature officially designated the California Dog-face as the official state insect.

Common Sulfur
(*Colias eurytheme*)

The caterpillars of this butterfly have a voracious appetite for alfalfa, earning them the scorn of

Figure 133. Common Sulfur: a.—adult male, b.—female, c.—larva, d.—pupa.

farmers throughout most of the western United States. Clover also serves as a food plant, and the larvae will feed on many other members of the pea family.

The sulfur yellow adults are a familiar sight in the alfalfa growing areas of the Imperial and Coachella valleys to the southeast. During the warm days of the growing season hundreds of individuals will be seen in the fields and milling back and forth across the highway. Many are caught in car radiators and may even pile up heavily enough to impair their function.

Occasional female specimens occur with white rather than yellow wings. This is a genetic variant produced by a dominant, sex-limited gene; yellow females are homozygous for the recessive allele.

Senna Sulfur
(*Phoebis sennae*)

Figure 134. Senna Sulfur, adult on pupal skin.

This is a tropical butterfly that inhabits our territory only sporadically. It is able to pass a succession of generations locally on cultivated "big-leafed" cassias, but appears to be unable to survive the winter and is, therefore, not a permanent resident.

The adults are brilliant yellow or yellow-green and have a characteristic rapid, dodging flight. The caterpillar is green and similar to that of the Cabbage White but larger. The chrysalis ranges in color from pink to green and has a swollen appearance in the middle because of the greatly enlarged wing cases; there is also a lateral yellow and green stripe on the abdomen.

Blues, Coppers, and Hairstreaks

Family Lycaenidae

Pygmy Blue
(*Brephidium exilis*)

Figure 135. Pygmy Blue.

This is one of the world's smallest butterflies; the wing expanse even of large individuals barely exceeds ½ inch. The upper surface is medium brown and the hind wing is margined with a row of dark spots which on the under side are defined by circles of metallic scales. The tiny grublike caterpillars feed on Salt Bush (*Atriplex*) and Pigweed (*Chenopodium*). The species is seen mainly in wild areas, especially where the salt-loving food plants grow, that is, in alkaline valleys and flats and along beach bluffs.

Marine Blue
(*Leptotes marina*)

This is another one of the butterflies which is common in local parks and gardens due to the fact that its larva feeds on the buds and blossoms of ornamental shrubs and vines (*Plumbago,* Wisteria Vine, sweet pea and other members of the Pea Family). Though a fairly close relative of the preceding species, its wing span is slightly less than 1 inch. The upper wing surface is pale lilac blue and slightly transparent, so that the ripplelike pattern of dark bands on the under side shows through faintly.

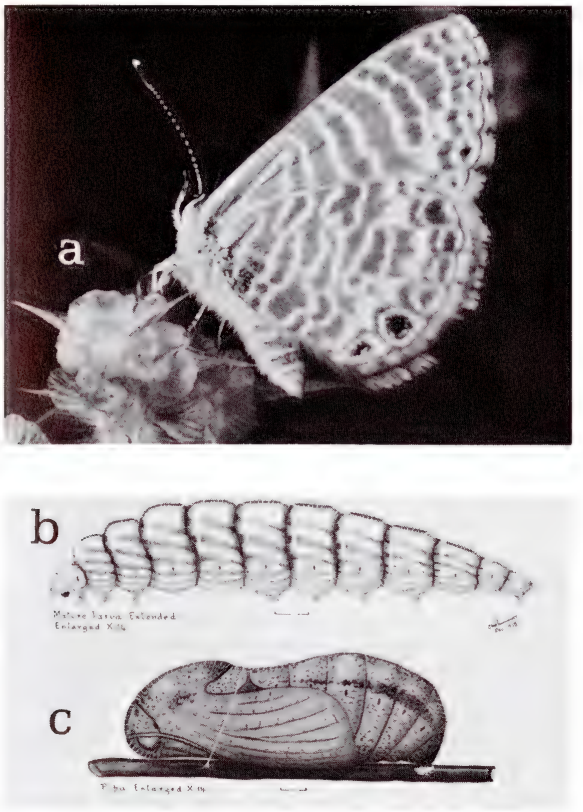


Figure 136. Marine Blue: a.—adult, b.—larva, c.—pupa.

Common Hairstreak
(*Strymon melinus*)

Figure 137. Common Hairstreak.

This species belongs to a group of small butterflies in which a hairlike appendage typically projects from the rear margin of the hind wing. This feature, and the plain slate-gray upper wing surfaces marked only on the hind wing by a crimson spot at the base of the tails, distinguishes it from its much less common local relatives.

The adults characteristically fly short distances in energetic bursts, then walk nervously about after landing, with the wings held tightly together above the back, stopping frequently to rub the hind pair together with a rotary motion. The significance of this peculiar latter behavior is not known.

The small sluglike larvae bore into the fruits and seeds of a great variety of plants. In some parts of its range the food plants include cultivated beans and sweet peas, causing the species to be considered a pest. In our area common mallow and hibiscus, around which the adults are frequently seen, are probably the principal hosts. In my garden I have observed females ovipositing on the buds of the latter in September; the larvae feed on the petals of the developing flower.

Skippers

Family Hesperiidae

Fiery Skipper
(*Hylephila phyleus*)

Figure 138. Fiery Skipper.

Also called the Lawn Skipper, this pale brown, mothlike species is exceedingly abundant in residential districts. Its scurrying flight over lawns and

sunning posture with wings spread open partially (fore and hind pair separated) are characteristics which identify it more readily than its anatomy.

The larvae feed on lawn grasses, possibly preferring Bent Grass and Bermuda Grass, and are distinguished from the common lawn cutworms by the large black head which is set off by a constricted prothoracic segment. They are seldom seen, however, even though abundant, because they conceal themselves in silken tubes woven through the under layer of the grass. The pupae are found here also.

Funereal Duskywing
(*Erynnis funeralis*)

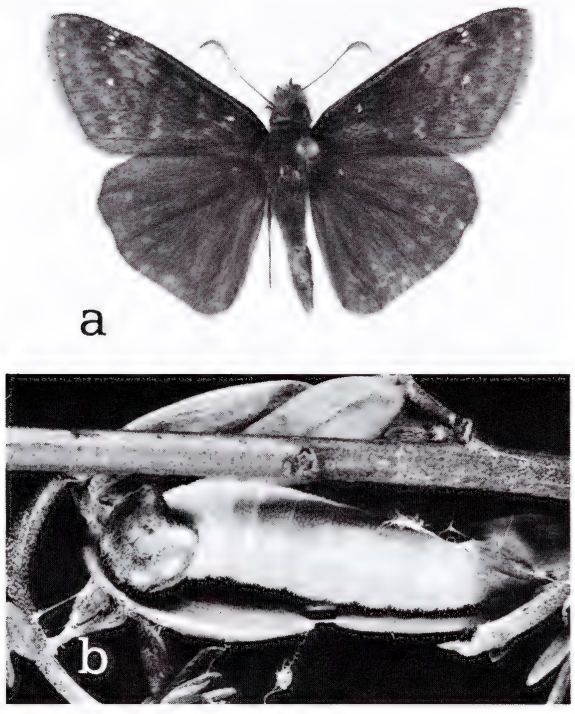


Figure 139. Funereal Duskywing: a.—adult, b.—larva.

This is a large, black skipper, characterized by the white fringe bordering the hind wing. It is common through the summer in hilly areas, buzzing from perch to perch in open areas of sparse herbaceous vegetation.

The larva is pale green and feeds on various leguminous plants. I have found them in the northern foothills on Deer-weed (*Lotus scoparius*). This is probably the usual food plant in our area. They may be found by searching for the loose chamber of leaves and silk in which they secrete themselves.

REFERENCE: Burns, J. 1964. *Erynnis funeralis*. Pages 173-182 *in* J. Burns. Evolution in skipper butterflies of the genus *Erynnis*. Univ. Calif., Pub. Entomol., vol. 37.

Flies

Order DIPTERA

The scientific name of this order of insects means "two-winged" (Greek: di = two; pteron = wing) and describes the chief feature of their anatomy which distinguishes them from other insects. Only the mesothoracic pair of wings are developed; evolution has modified the hind, or metathoracic pair, into small, knobbed structures (balancers) which function as sense organs, providing the fly with information on its flight position. They have been analogised with the gyroscopic attitude instrument of an airplane.

Flies generally are excellent aeronauts and include the fastest fliers. However, the popularly publicized, incredible speeds (faster than the speed of sound!) accredited them by some earlier workers, are far from actually realized. The horse fly has been clocked at around 45 miles per hour; certain warble or bot flies probably are capable of reaching speeds of 60 miles per hour or more.

Flies also may move their wings up and down very rapidly. Some fantastic wing beat frequencies recorded for flies are: housefly, 200 per second; mosquitoes, 600; and biting midges of the family Ceratopogonidae, 1000 beats per second. The beat is often so rapid that it really becomes a vibration like that of a tuning fork and may give rise to a hum or buzz. This accounts for the irritating whine of the mosquito.

The metamorphosis of flies is of the complete type. The larvae, at least of the majority of the more highly evolved flies, are wormlike creatures, without a head or appendages of any kind, and are called maggots. Prior to pupation, maggots form neither protective cocoon nor earthen cell. Rather, a unique capsulelike structure develops around the pupa and keeps it safe from desiccation and injury like the hull of a seed surrounds and protects the kernel. This structure, called a puparium, is derived from the last two skins of the larva which are detached during the pupal molt

but not discarded. The adult fly escapes from the puparium by popping one end off with balloonlike organ on the head.

The word "fly," usually brings to mind the House Fly (*Musca domestica*), or similar species. Actually, throughout the world, the order Diptera includes some 80,000 diverse forms divided into two very broad groups. The first and more primitive group contains the gnats and midges. These are generally small, frail bodied and long-legged flies, typified well by the mosquito which itself may be considered a biting gnat.

The second group, which are the "flies proper," contains relatively robust flies with short legs. The common House Fly is the best example.

There are a large number of fly species in the Basin belonging to both groups. The following are the most conspicuous and common:

REFERENCES: Oldroyd, H. 1964. The natural history of flies. Norton, N.Y.
Cole, F. 1969. The Flies of Western North America. Univ. Calif. Press, Berkeley.

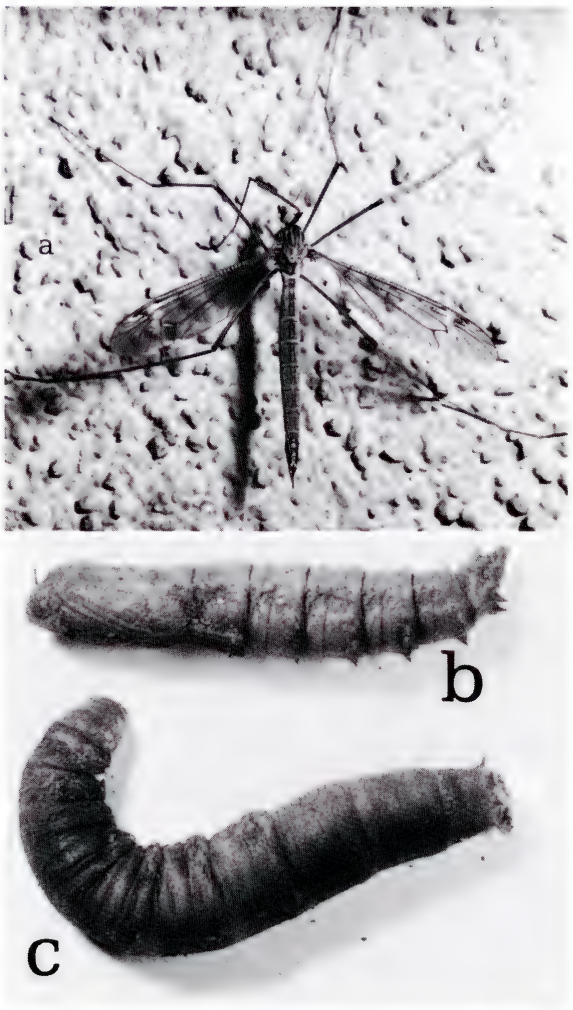


Figure 140. Common Crane Fly: a.–adult female; b.–larva; c.–pupa.

Crane Flies

Family Tipulidae

Frequently seen indoors resting on walls, ceilings and windows, these flies are often mistaken for "giant mosquitoes." They are not closely related to mosquitoes in spite of their similar appearance; they possess short, soft mouth parts incapable of biting. An added characteristic of the family is long, ungainly legs which break off easily.

There are many species living in the Basin. The commonest one is the following:

Common Crane Fly
(*Tipula planicornis*)

This is a medium-sized, light brown species (body length ½ - ¾ inch), seen indoors as often as out, resting on walls, window panes, and about lights.

The stout wormlike larvae, called "leather jackets" because of their thick, dark skin, live in damp, loose soil or leaf mold and feed on the roots of succulent plants.

A second species is noteworthy because of its large size:

Giant Crane Fly
(*Holorusia grandis*)

This is one of the world's largest flies. The body length of average female specimens reaches 1⅜ inch, and a wing expanse of nearly 3 inches is frequent. The body is reddish brown with white areas on the sides of the thorax.

The fly is most often seen during the springtime in grassy areas near streams. Its large, wormlike larva is semi-aquatic to aquatic, living in shore vegetation or trash and on the bottom of small stream pools.

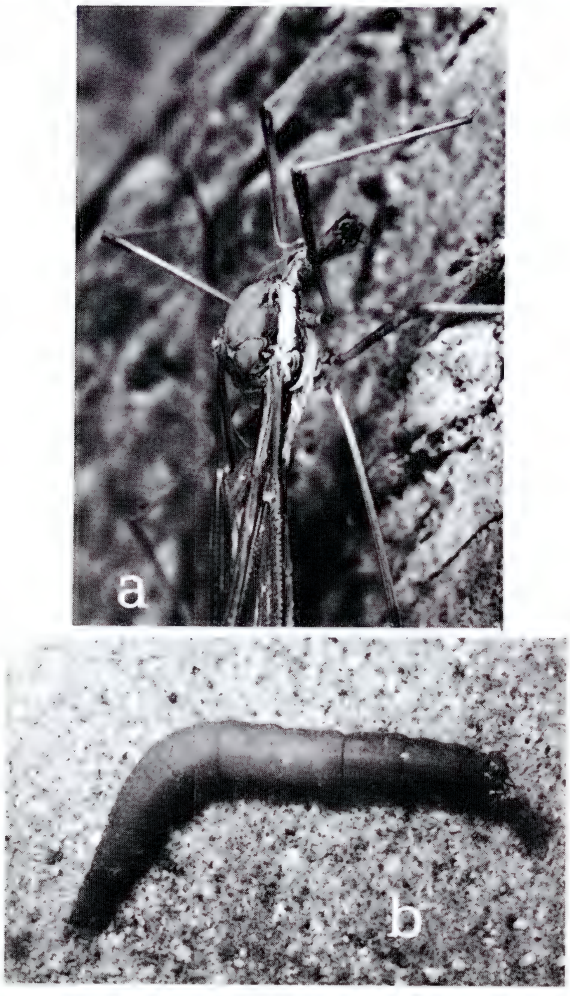


Figure 141. Giant Crane Fly: a.—adult, b.—larva.

Mosquitoes

Family Culicidae

No group of insects has received more attention from scientists, physicians, politicians, generals, sportsmen and citizens at large, than mosquitoes. The reason is apparent when one realizes that in addition to the annoyance of their bite and buzz, they act as vectors of a long list of man's worst diseases. At the top of this list is malaria. For centuries this disease has out-ranked warfare as a source of human suffering, and it continues today to kill and depress the energy of more souls than any other ailment.

Thanks to an intensive control program extending over the past 50 years, this disease has practically vanished in the United States. As late as 1916, the great Central Valley of California had a death rate due to malaria of 14.2 per 100 thousand population. Today, a case of malaria is a novelty and always traceable to some special circumstance, usually involving a single carrier who has infected a few mosquitoes in a restricted location. The main share of credit for the victory over malaria in our state is traceable to the California Legislature of 1915. Passed at that time was the "Mosquito Abatement District Act" under which mosquito control could be carried on by organized districts throughout the state. Presently there are over 50 agencies in the state organized for mosquito control purposes.

In the Los Angeles Basin, the health danger from malaria is virtually non-existent. The public health menace of mosquitoes persists here, however, in part from their nuisance value but more importantly from their ability to transmit Encephalitis, a disease caused by certain specific strains of viruses and producing inflammation of the brain. Mosquito borne encephalitis is commonly called "sleeping sickness," but it is not to be confused with tropical African Sleeping Sickness, a very different disease caused by a species of trypanosome protozoa and transmitted by tsetse flies.

The Western Encephalitis Mosquito (*Culex tarsalis*) transmits the viruses to man from wild birds. The latter carry the viruses in their blood but do not manifest the disease. Mosquitoes feeding on infected birds pick up the viruses and may later inject them with their saliva into the blood stream of a healthy person. The most serious epidemic of encephalitis in California's history occurred during the summer of 1952 when 792 cases were reported.

All mosquitoes are not important disease carriers, even though most feed on the blood of man and other vertebrate animals. Only the female bites; the male, recognizable by its bushy antennae, feeds on nectar and fruit juices.

Mosquitoes are good fliers. Though most species stay near the vicinity of their birth, some stray many miles on dispersal flights. The characteristic buzzing sound which they emit during flight is caused by high frequency vibration of the wings.

All mosquitoes require standing or near standing water in which to develop. The fertilized female lays her eggs directly on the water surface or upon surfaces which will later become covered with water. The larvae are active creatures commonly called "wigglers." They often rest just below the water surface, taking in air with the elongate breathing tube at the tail end of the body as they feed on microscopic organisms suspended in the

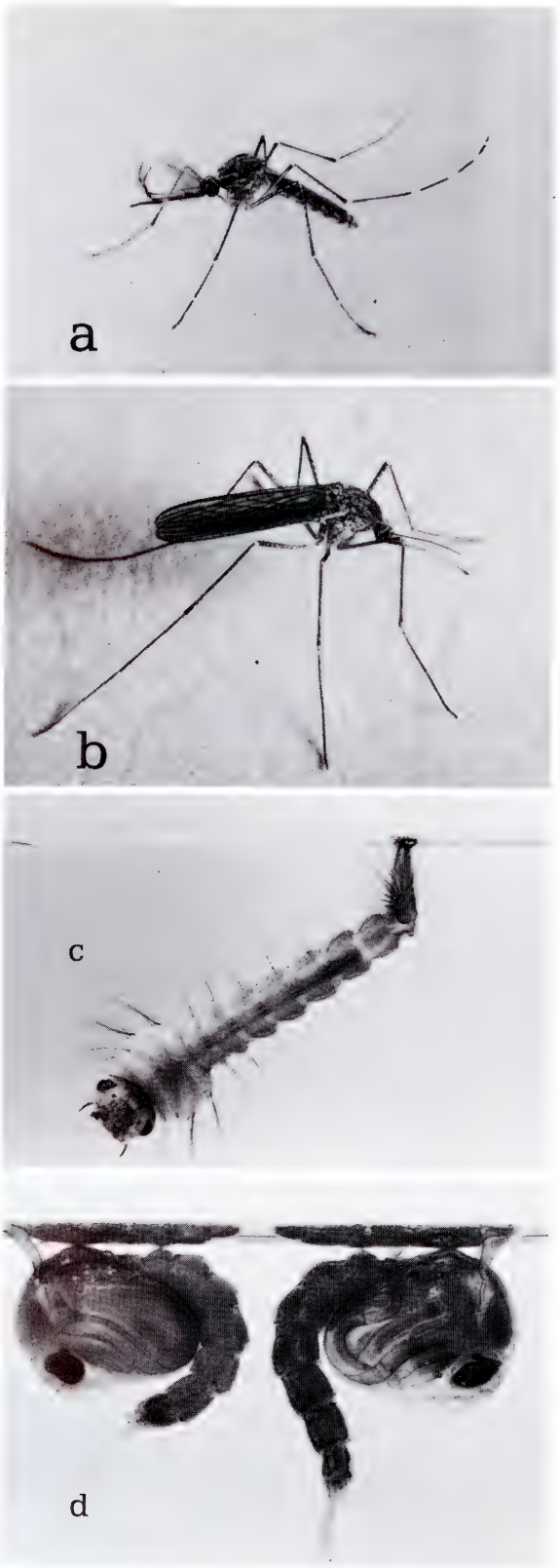


Figure 142. Mosquitoes: a.–adult male, b.–adult female, c.–larva, d.–pupae.

water. Feeding is essentially a straining operation which is carried out by rapidly vibrating brushlike mouthparts. After four molts the larvae are mature and transform into pupae which are called "tumblers," and which are unusual among insect pupae in that they are very active. To the unaided eye they appear like small seeds, each with an elongate, curved tail with paddles on the end. The tail moves back and forth rapidly and propels the pupa through the water. The pupa does not feed and, unless disturbed, lies quietly just below the water surface.

Several species of mosquitoes are found in the Basin. The most common ones are listed below in order of importance and abundance:

1. Southern House Mosquito (*Culex quinquefasciatus*).
Breeds in foul water such as is found in septic tanks, drains, gutters, and like places. Adults are domestic and are frequently found indoors where they bite man readily.

2. Foul Water Mosquito (*Culex peus*).
Breeds in foul water like the previous species, though it is found also in temporary accumulations of fresh water. Adults hardly ever feed on man.

3. Western Encephalitis Mosquito (*Culex tarsalis*).
Breeds in almost any water accumulation. Adults are strong fliers and readily bite man and birds. This is the vector of Virus Encephalitis.

4. Tule Mosquito (*Culex erythrothorax*).
Breeds in all kinds of large shallow ponds which have a heavy growth of emergent vegetation, especially tules. Adults readily bite man.

5. Winter Mosquito (*Culiseta inornata*).
Breeds in most kinds of ground pools and in artificial containers like tin cans, wading pools, old tires, etc. Adults will bite man but prefer other hosts.

6. Cool Weather Mosquito (*Culiseta incidens*).
Breeds in almost any accumulation of water. Adults occasionally bite man but prefer the blood of fowl and domestic animals. Most abundant during cooler seasons. The species is readily recognized by its large size and speckled wings.

7. Western Tree Hole Mosquito (*Aedes sierrensis*).
Larvae found exclusively in treeholes (especially oaks and cottonwood). Although the adults are major pests elsewhere, they do not seem to be readily attracted to humans locally.

8. Field Mosquito (*Anopheles franciscanus*). Breeds in clear ground pools with abundant algal growth. Adults prefer the blood of domestic stock, but occasionally attack man.

9. Western Malaria Mosquito (*Anopheles freeborni*).
Same general habits as the preceding.

REFERENCE: Carpenter, S. and W. LaCasse. 1955. Mosquitoes of North America (North of Mexico). Univ. Calif. Press, Berkeley.

Biting Gnats

In our area there are two families (Simuliidae and Ceratopogonidae) of gnatlike flies in addition to the mosquitoes, which contain species with blood-sucking habits.

Fortunately, these gnats are only minor pests in our area, because they occur primarily in mountainous areas where there are few people. Possibly, as more residences are built in the Santa Monica Mountains and other locales where they breed, complaints against biting gnats will increase. Like the mosquitoes, only the females bite.

Black Flies

Family Simuliidae

Figure 143. Black fly (*Simulium*).

Also called "buffalo gnats" because of their hump-backed form, these small flies commonly attack man and domestic animals, or birds. Locally they are most common in the Santa Monica Mountains and foothills, near streams where their larvae breed in tremendous numbers. The latter are found in flowing water, usually in masses on smooth stones, vegetation or other objects where the current is swiftest.

This is one of the few Diptera whose larvae form a cocoon to protect the pupa. The cocoon is attached to an underwater object, and the adult rises to the surface in an air bubble at the time of emergence.

Adults bite mainly during the daytime, where it is shady, and in still air. Although human skin reaction to the bite may be quite severe, no diseases are transmitted by these flies in our area.

Our simuliid fauna consists of but a few species in the genus *Simulium*.

REFERENCE: Hall, F. 1972. Observations on black flies of the genus *Simulium* in Los Angeles County, California. Calif. Vector Views, vol. 19, pp. 53-58.

Punkies

Family Ceratopogonidae

These minute gnats deserve their pidgin-English name, "no-see-ums," for they are indeed almost too small to be seen, even when their presence is painfully announced by their bite. It is truly said that the effects of the bite are way out of proporton to the size of the biter. Specimens of most species barely reach 1/32 inch in length and can easily pass through ordinary window screen.

There are numerous species of several genera in our part of the state. However, only members of the genera *Leptoconops* and *Culicoides* are bloodsucking. The former genus contains the Valley Black Gnat (*L. torrens*) and the Bodega Gnat (*L. kerteszi*), notorious biters in other parts of the world. These species occur only sporadically in the Basin. The first passes its larval stage in damp sand containing some organic matter, at or just above high-tide level in the mouths of fresh-water streams entering the sea; the second species passes the larval stage in inland deposits of clay or clay-adobe soils.

The immature stages of most other punkies are aquatic. Elongate, eellike forms, the larvae live as predators or scavengers in the bottom mud or vegetation of various accumulations of water. The pupae are similar to those of mosquitoes.

Punkies usually bite about the ankles. The effects are a transient inflammatory swelling followed by intense itching which may continue for a week or longer. A water filled blister may also form at the site of the bite.

REFERENCES: Smith L. and H. Lowe. 1948. Black gnats of California. Hilgardia, vol. 18, pp. 157-183.

Whitsel, R. and R. Schoeppner. 1966. Summary of a study of the biology and control of the valley black gnat, *Leptoconops torrens* Townsend (Diptera: Ceratopogonidae). Calif. Vector Views, vol. 13, pp. 17-25.

Non-Biting Gnats and Midges

Periodic outbreaks of tiny black flies occur frequently in the Basin and attract attention from home owners who despair of picking gnats from their breakfast cereal. Although they do not bite or carry disease, gnats can be extremely annoying.

Only a few principal species in the following three families are involved:

Root Gnats

Family Sciaridae

Figure 144. Root gnat.

The larvae live in decaying plant material such as compost, peat, etc., also commonly infesting roots and stems of various herbaceous plants. They may develop in the media used for potted plants, which explains their otherwise mysterious appearance indoors.

March Flies

Family Bibionidae

Adults of some southern California species appear earlier or much later in the year, making the common name of this family somewhat inappropriate. The adults are poor fliers, and they are often described as those "little black bumbling gnats." The larvae are primarily scavengers, living in decaying organic materials in the soil and among the roots of grasses and other plants.

The two commonest local species are *Philia orbata* and *Bibio albipennis*. The larvae of the latter may occur in large numbers under turf, where they do little or no direct damage. They are recognizable by a leathery gray warty skin, distinct brown head, and enlarged posterior paid of spiracles. Also characteristic is their habit of freezing rigidly when disturbed.

Figure 145. March fly.

REFERENCE: Hardy, E. 1961. The Bibionidae of California. Calif. Insect Surv., Bull., vol. 6, pp. 177-195.

Water Midges

Family Chironomidae

Figure 146. Water Midge.

Water Midge larvae develop in shallow areas of lakes, ponds, and streams, favored by heavy growth of aquatic plants. Adults may emerge in such numbers as to become distinct pests around

lake and stream-side homes, resorts and in waste stabilization lagoons. Small clouds of males are frequently seen hovering in the air over or near the water; tremendous numbers may swarm around lights on warm summer evenings.

REFERENCE: Grodhaus, G. 1967. Identification of chironomid midges commonly associated with waste stabilization lagoons in California. Calif. Vector Views, vol. 14, no. 1, pp. 1-12.

Horse Flies

Family Tabanidae

Big Black Horse Fly
(*Tabanus punctifer*)

Figure 147. Big Black Horse Fly, adult male.

Due to the disappearance of their aquatic breeding places, or chemical treatment, horse flies are now rare in the Basin. Larvae of this species still occur occasionally in marshy ponds, along lake or stream margins, in sloughs, irrigation ditches and similar watery habitats, usually in wet mud or decaying vegetation just above the water line.

The adults are large, robust flies, nearly ¾ inch in body length. Males possess very large eyes which meet on the mid-line of the head, making it appear to be nearly all eye; the back of the thorax is black except for a fringe of white hairs along the lateral and posterior edges. Females differ in having widely separated eyes, while the back of the thorax is all white or yellowish white.

Females of this species glue their elongate eggs in dense masses to bullrush stems, coarse grasses, trunks of small trees and other vegetation overhanging water surfaces, at heights varying from 1-3 feet. Upon hatching, larvae drop into the water where they feed on other aquatic invertebrates (snails and relatively sedentary bottom and shore-dwelling insects), including other horse fly larvae. Full grown larvae are wormlike, about 1⅞ inch long, with rounded lobes circling the anterior third of each abdominal segment. Pupation occurs out of the water in damp shore trash or loose soil.

Possessing a voracious appetite for blood of horses and cattle, the female flies, when numerous, may be extremely bothersome. Occasionally they bite man, with painful results. Natural saccharine fluids nourish the non-biting males, serving also as a diet supplement for the females.

REFERENCE: Webb, J. and R. Wells. 1924. Horse-flies: biologies and relation to western agriculture. U. S. Dept. Agr., Dept. Bull. 1218.

Flower Flies

Family Syrphidae

Numerous species of these common flies occur in the Basin. Typically the adults hover about flowers and, upon landing, reveal a wasplike, black and yellow abdomen. The larvae of most forms are beneficial, being predaceous on other, often injurious, insects. They may live on plants, as do our most prevalent species in the genera *Syrphus, Metasyrphus, Scaeva* and *Allograpta,* and do considerable good destroying aphids in gardens.

Other syrphids, such as the two following, have very different habits in the immature stages:

Drone Fly
(*Eristalis tenax*)

This fly receives its common name from its resemblance to the drone Honey Bee (male, *Apis mellifera*). Moderately large, (length ⅝ inch) and similarly colored, it behaves also like the bee, buzzing loudly when restrained. Although beelike

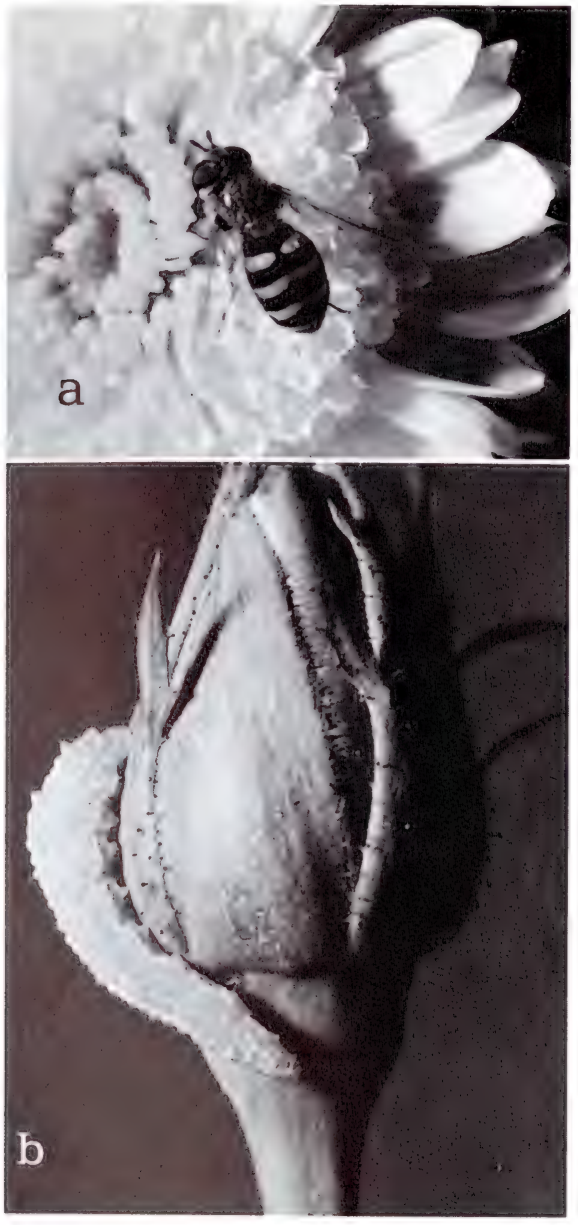


Figure 148. A common flower fly: a.—adult, b.—larva.

in appearance it is, of course, still a fly and has no sting.

Adults may be quite abundant in flower fields and occasionally enter homes. The larvae live in water, usually in sluggish streams or small stagnant ponds foul with organic matter; they may also breed in fresh, liquid cow manure. Because of their extremely long, extendable posterior breathing tube, the larvae are called "rat-tailed maggots."

Figure 149. Drone Fly.

Cactus Fly
(*Volucella mexicana*)

Figure 150. Cactus Fly.

A giant member of the Flower Fly family (body length ⅝-¾ inch), with a purplish black body, this species is seen occasionally in the spring and early summer in areas where large cacti grow. The larvae feed in dead and decaying tissue of that plant.

Robber Flies
Family Asilidae

Bumble Bee Robber Fly
(*Mallophora fautrix fautricoides*)

Figure 151. Bumble Bee Robber Fly, with prey.

Large and robust size (length ⅝ inch), powerful flight and a dense covering of similarly patterned yellow and black hairs create a resemblance of this fly to the bumble bee. Both males and females are predaceous, feeding on the blood of other insects which are often captured on the wing, dragged to a perch and drained of their fluid at the fly's leisure. A taste for honey bees, which seem to be preferred prey in Southern California, earns them the name "bee killers."

Very little is known of the life cycle. The larvae of this species probably develop in the soil. It is not certain whether they feed on animal or vegetable material.

Soldier Flies
Family Stratiomyidae

Window Fly
(*Hermetia illucens*)

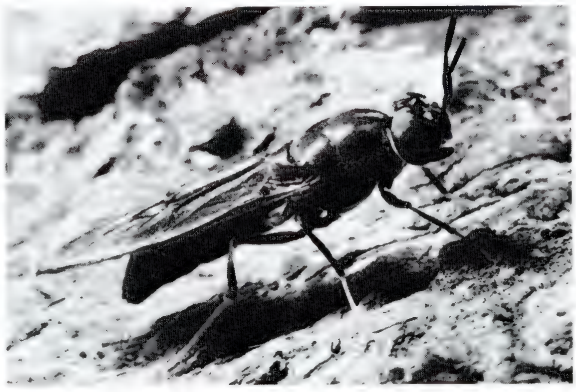


Figure 152. Window Fly.

Resembling a black wasp with buzzing flight, this moderately large fly (about ⅝-¾ inch long) is shiny black in color, with dusky wings and a pair of translucent areas ("windows") at the base of the abdomen. A thin longitudinal black line between the windows creates the illusion of a narrow waist. The adults are sluggish until induced to fly. They may be attracted to lighted buildings but do not molest human food.

The larva is robust, broadly-oval in outline and somewhat flattened, with tough and leathery skin and clothed with numerous short bristles. It is terrestrial and breeds in various organic substances, commonly decaying fruits and vegetables. In urban areas infestation probably occurs in garden soil where compost and ground mulch is accumulated, and near garbage pails placed on the ground. It is also found in defunct honeybee combs in our area.

There is no certainty that putrifying materials are actually the larva's food. There is evidence that, in such media, other fly larvae (or insects such as honeybee larvae) may be present and be preyed upon by the Window Fly larvae.

In spite of the aggressive appearance of the adult fly it neither bites nor stings.

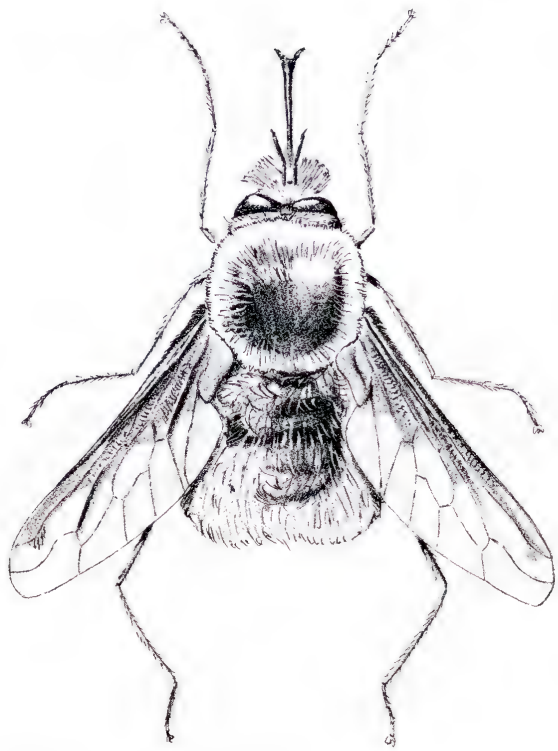


Figure 153. Large Bee Fly.

Bee Flies

Family Bombyliidae

Large Bee Fly
(*Bombylius major*)

This is a typical member of a group of common flies called bee flies (Family Bombyliidae) because of their furry beelike bodies and nectar feeding habits. Feeding is accomplished with a long, slender proboscis (nearly as long as the body). The body is ¼-½ inch long and densely covered with soft, whitish, yellowish and brownish hairs; the anterior half of the wings is opaque dark brown to black.

Frequently seen on warm days hovering in front of flowers, they often come to rest on a flower or upon the ground with the characteristically-marked wings held out flat to the sides.

The larvae are said to live in the nests of solitary bees (*Andrena, Halictus,* and *Colletes*) on whose young they prey.

Figure 154. Tachinid Fly.

Tachinid Flies

Family Tachinidae

Most species of this group resemble overgrown house flies covered with heavy, stiff bristles. The thorax is not banded lengthwise, distinguishing them from other domestic flies.

They are often seen flying closely over or crawling through low vegetation in search of caterpillars (cutworms and the like) upon which to lay their eggs. The larvae parasitize caterpillars and so are of benefit in controlling pests in the garden.

Domestic Flies

In this group are several fly species which are more or less adapted to conditions produced by civilization, especially the organic waste which serves as the principal food of the larvae. Adults frequently enter houses and are very pesky with their buzzing and crawling habits. Furthermore, since the adults frequent filthy places, climbing over feces, garbage and other substances commonly contaminated with disease organisms, some may pick up and transmit germs in a mechanical way on their feet, mouthparts, and body.

The House Fly is the best known member of this category; people often fail to discriminate between it and other species. Commonly any bothersome fly found in the home is called a "house fly."

REFERENCE: Ecke, D., Ed. 1963. A field guide to the domestic flies of California. Calif. Mosquito Control Ass., Field Guide Ser., Pub. 3.

Muscid Flies

Family Muscidae

House Fly
(*Musca domestica*)

Figure 155. House Fly.

The House Fly is a truly domestic insect, so closely adapted to man's environment that it is rarely found away from human habitations. The species is our number one pestiferous fly occuring throughout the Basin.

The fly's color is generally dull grayish brown; there are four dark longitudinal stripes on the back of the thorax, most clearly defined toward the front. Length of the body is slightly over ¼ inch. At rest, the wings are held out at a slight angle from the body, giving the fly a triangular shape when viewed from above.

All kinds of decaying and fermenting organic material, commonly feces of dogs, cats, horses, rabbits and poultry, decomposing lawn clippings and garbage, provide a breeding place for the larvae. Adult flies feed on liquids containing high concentrations of organic substances, such as syrups, milk, sputum, and other animal secretions. Dry materials may also be used as food, in which case the fly regurgitates a bit of liquid from its mouthparts, then drinks the dissolved surface. Frequent regurgitation on almost every surface upon which it rests results in the small, brown opaque spots we call "fly specks."

House Flies are vigorous insects and may breed throughout most of the year in the Basin. They are most common, however, during the warmer months.

Because its mouthparts are soft and adapted for sponging up free liquids only, the House Fly does not bite man. Suspected instances of House Fly bites are attributable to the next similar species.

REFERENCE: West, L. 1951. The Housefly. Comstock Publ. Co., Ithaca, N. Y.

Stable Fly
(*Stomoxys calcitrans*)

About the same size as the House Fly and resembling it fairly closely, this species can be distinguished easily by its heavy, shiny black, hard, non-retractable proboscis. This proboscis, unlike that of the above species, is adapted for blood sucking and can—and does—readily pierce the skin of man and animals. Distinct rounded spots on the abdomen of this species are lacking in the House Fly. Both male and female Stable Flies are vicious biters, especially during warm humid weather. They are most common in late summer and fall and are frequently seen resting on the sunny surfaces of houses, cars, fence posts, etc.

The breeding habits of this species are similar to those of the House Fly. The maggots develop in animal manure and waste material around farms, and in compost and piles of lawn clippings in urban areas. They are also found in piled seaweed along

Figure 156. Stable Fly. (From Greenberg, B. 1971. Flies and disease, vol. I)

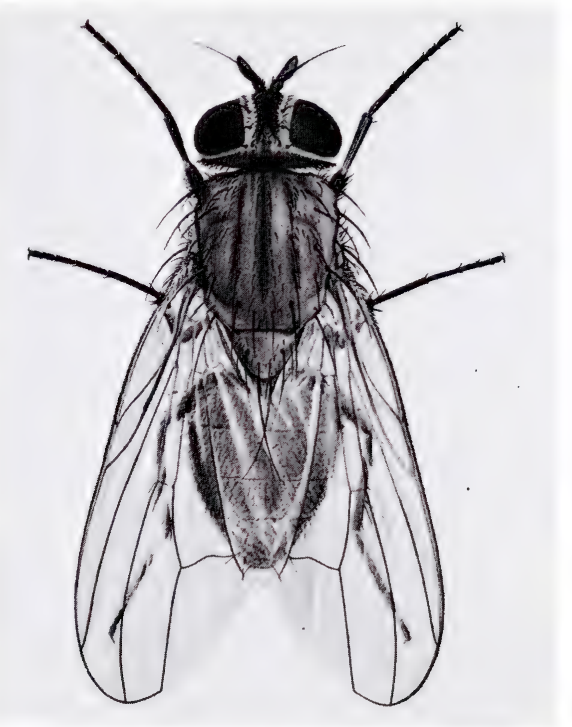


Figure 157. Little House Fly. (From Greenberg, B. 1971. Flies and disease, vol. I)

beaches and may give rise to concentrations of adult flies which are extremely annoying to bathers (Beach Flies).

Little House Fly
(*Fannia canicularis*)

Here is the fly you see in your garage on hot summer days, in the shade of trees, doorways and other shaded places, hovering in the air, seeming never to land nor to have a place to go. This aimless flight immediately distinguishes this species from the other domestic flies in our area, which frequently come to rest and fly with direction. These swarms consist mainly of male flies; the females usually remain at rest nearby.

The Little House Fly is smaller (3/16 inch long) than the House Fly and has a slightly more slender body. Though a maggot, the larva is atypical in its flatness and possession of numerous branched projections radiating from the body.

Breeding occurs in a wide variety of rotting organic materials. The larvae show some preference locally for chicken manure, and the species abounds around poultry ranches. In urban areas breeding sites are similar to those of the other domestic flies.

False Stable Fly
(*Muscina stabulans*)

Figure 158. Flesh Fly.

The False Stable Fly also resembles the House Fly but is larger (about ⅜ inch long) and the tip of the scutellum is pale yellow. The abdomen is almost black, covered with gray in places, giving it a blotched appearance. Its adult and larval habits are similar to those of the House Fly.

Flesh Flies

Family Sarcophagidae

Resembling overgrown House Flies, most individuals of this species are overall gray in color, the thorax being longitudinally striped with black, while the abdomen is marked by a checkerboard pattern of light and dark spots which seem to change positions according to the angle of reflected light. Males of many species have a red tipped abdomen.

Primarily, this family contains wild flies, but they do enter dwellings when breeding sites are numerous and located nearby. Larvae live in decomposing organic matter, particularly discarded meat, and fish and animal carcasses. They frequently infest the remains of poisoned garden snails.

Unlike the other flies mentioned here, many Flesh Flies do not lay eggs but give birth to living larvae. Adults feed similarly to House Flies and do not bite.

Blue Bottle Flies

Family Calliphoridae

Figure 159. A typical calliphorid fly, the Green Bottle Fly.

These are large, hairy, blue-black flies. The thorax of the majority of species is dull blue to black, the abdomen deep metallic blue. Breeding usually takes place in the meat of fresh animal carcasses. Such carcasses are frequently in a bloated or blown state and these flies by association have been given the name "Blow Flies." The word "bottle" as used in the present sense has nothing to do with a vessel for holding fluids but represents the diminutive form of the word "bot" = "Little Bot," that is, a small bot fly. "Large" Bot fly larvae (Cuterebridae and relatives) infest living animal tissue.

REFERENCE: James, M. 1955. The blowflies of California. Calif. Insect Surv., Bull., vol. 4, no. 1.

Several species occur locally; the commonest are the following:

1. Green Bottle Fly (*Phaenicia sericata* and *cuprina*).

Body light metallic green or bronzy throughout. The principal flies infesting garbage pails in the Basin.

2. Common Blow Fly (*Eucalliphora lilaea*).

Variable; typical specimens with thorax black; abdomen dull, deep blue without lines and usually slightly broader than thorax. Breeds in freshly killed carcasses of small animals. Adults readily enter houses and may also occur there as a result of emergence from the bodies of poisoned or trap-killed mice.

3. European Blue Bottle Fly (*Calliphora vicina*).

Superficially identical to the foregoing.

4. Black Blow Fly (*Phormia regina*).

Body dark, dull metallic blue throughout; thorax without lines, abdomen as narrow as thorax.

5. Wheeler's Blue Bottle (*Paralucilia wheeleri*).

Thorax and abdomen deep metallic blue; thorax and abdomen with three strong dark lines.

6. Cluster Fly (*Pollenia rudis*).

Body non-metallic throughout; long crinkly golden hairs over most of body. The larvae are internal parasites of earthworms. Adults occasionally enter houses to hibernate, but the species is generally scarce in our region.

Robust Bot Flies

Family Cuterebridae

Wood Rat Bot Fly
(*Cuterebra latifrons*)

This large fly (body often exceeding ¾ inch long) is seldom seen or recognized, because it is a wild species with fleeting habits. The body is very bulky, looking very much like that of a bumblebee, and black in color, with the exception of an area of dense white velvet over the lower half of the head and thorax; the abdomen is also somewhat mottled on the sides. The wings are dusky brown.

Figure 160. Wood Rat Bot Fly: a.—adult, b.—wood rat infested with larvae.

The full-grown larva of this fly is a very large, spiny-skinned grub (bot or warble) which develops within the bodies of wood rats (*Neotoma fuscipes*). Females lay their eggs on the sticks making up the rat's nest, mostly near the entrances to tunnels. The larvae develop within the egg shell but do not hatch until stimulated by the motion and body heat of a passing rat. They attach to the host and quickly burrow into its body through mucous membranes and then migrate deeply through internal tissues. The mature (third instar) larvae lie just beneath the skin, often about the neck and shoulders, forming a swollen nodule with a hole in the center through which they breathe. The posterior breathing pores may be seen as the larva presses them against the hole to inhale air from the outside. When the larva is ready to pupate, it emerges through this hole and drops to the ground where it forms the usual protective puparium.

The feeding and burrowing of these endoparasites seem to do little harm to the host and the wounds produced by the warbles heal quickly.

There are two additional species of wild bot flies in the Basin: *Cuterebra tenebrosa* (also on wood rats) and *C. lepivora* (on cottontail rabbits).

All adult bot flies lack mouthparts and do not feed.

REFERENCE: Catts, E. 1967. Biology of a California rodent bot fly *Cuterebra latifrons* Coquillett (Diptera: Cuterebridae). J. Med. Entomol., vol. 4, pp. 87-101.

Vinegar Flies

Family Drosophilidae

Fruit Flies
(*Drosophila*)

Figure 161. Fruit fly *(Drosophila).*

"Fruit Fly" is an unsatisfactory name for these insects, because it also refers to another group, the "true" Fruit Flies (Family Trypetidae), whose larvae feed on growing fruit. Other names for *Drosophila* are Pomace Flies, Sour Flies and Vinegar Flies. The small maggot larvae of our several common species live in fermenting fruit, feeding on the yeasts which flourish in such material.

The adults of the commonest species, *Drosophila melanogaster*, are usually associated with

man, in houses, orchards and fields and as habitual inhabitants of fruit racks in grocery stores. These tiny red-eyed, orange-bodied, gnat-like flies seem to appear out of nowhere when a lunch bag is opened or a banana is peeled. Their olfactory senses, which are located in the third antennal segment, are extremely keen, and they respond to the odors of the various volatile organic compounds in fruits from a considerable distance.

Drosophila melanogaster is the famous Fruit Fly of genetics research. Doubtless more is known about the heredity of this species than about any other organism on earth. Detailed maps have been drawn of the giant chromosomes found in the cells of the larva's salivary glands. The theory of heridity as it is now generally accepted was first based chiefly on the results obtained with this fly. This particular species was chosen for this type of scientific work because of its short life cycle, great productivity and the ease in which it may be bred and manipulated in large quantities.

REFERENCES: Demerec, M., Ed. 1950. Biology of *Drosophila*. Wiley, N.Y.

Demerec, M. and B. Kaufmann. 1965. (Seventh edition). *Drosophila* guide. Introduction to the genetics and cytology of *Drosophila melanogaster*. Carnegie Inst. Wash., Wash. D.C.

True Fruit Flies

Family Trypetidae

Figure 162. A true fruit fly, the Mediterranean Fruit Fly.

The confusion of names between this group and the drosophilid fruit flies has already been mentioned. Members of this family are readily distinguished from the latter by their "pictured" wings, that is, wings distinctly marked with a pattern of black, brown, or vari-colored spots or bars.

The larvae typically feed on the interior of growing fruit, and many species are highly destructive to citrus, pome, and other fruit and vegetable crops. The Mediterranean Fruit Fly (*Ceratitis capitata*) belongs in this category and is the species of greatest economic importance. Fortunately, it does not now exist in the Continental United States, but, because there is an ever increasing likelihood of introduction, it poses a constant threat to the country's agricultural future.

The most common injurious species among the several in the Basin is the Walnut Husk Fly (*Rhagoletis completa*), which primarily infests walnuts.

REFERENCE: Foote, R. and F. Blanc. 1963. The fruit flies or Tephritidae of California. Calif. Insect Surv., Bull., vol. 7.

Shore Flies

Family Ephydridae

Petroleum Fly
(*Helaeomyia petrolei*)

Figure 163. Petroleum Fly.

Living in our area is one of the world's biological curiosities. This is the Petroleum Fly, so called because the larva lives its entire life submerged in the pools of crude oil which accumulate around natural oil seeps and in commercial oil fields. Oil pool maggots have been known to petroleum technologists for many years, but it was not until 1898 that the maggots were reared and their nature defined. It is not certain what physiological adaptations permit this maggot to live in this inhospitable medium, although an exceptionally impermeable cuticle probably helps.

Experiments indicate that the maggots feed primarily on larger animals, especially insects, that fall into the oil. The evidence that the larvae cannot subsist on the oil alone is fairly conclusive, although more research along these lines is indicated. Under natural conditions the larvae are constantly in motion, imparting a shimmering effect to the surface of the oil.

Larvae leave the oil to pupate, forming puparia on nearby dry debris and vegetation. The small, black, gnatlike flies, (about 1/16 inch long) stay in the immediate vicinity of the pools, hiding in soil cracks or walking about on oily surfaces.

The species is known throughout the oil fields of southern California and is also reported from Cuba and Trinidad.

REFERENCE: Thorpe, W. 1930. The biology of the petroleum fly (*Psilopa petrolii*, Coq.). Entomol. Soc. London, Trans., vol. 78, pp. 331-337.

Louse Flies

Family Hippoboscidae

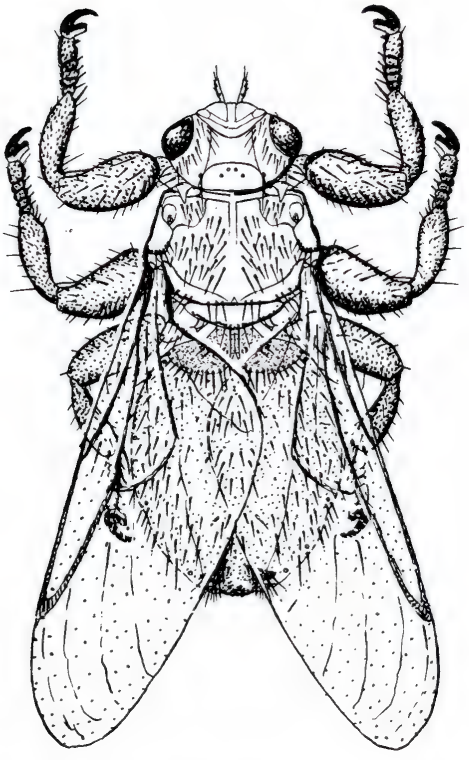


Figure 164. Deer Louse Fly. (From Bequaert, J. 1942. Entomol. Amer., vol. 22:49)

Occasionally, persons hiking or working in mountainous areas will notice a small (⅛ inch long), flattened, brown fly land on their arm or clothing. Looking much like a tick, except for the wings, the fly clings tenaciously or crawls sluggishly for a moment before flying away. This is one of the Deer Louse Flies (*Neolipoptena ferrisi* or *Lipoptena depressa*), both fairly common local species which normally live as ectoparasites on deer. Large numbers (as many as a thousand or more) may infest the hide of a single animal.

On emergence from the pupa this fly possesses fully developed, though fragile, wings and flies among the trees or shrubs in search of the host. This stage survives but a few days in the absence of the normal host. However, upon successfully finding a deer, it immediately crawls through the hair to the skin and begins to suck blood. Here it remains as a permanent parasite, soon losing its wings through the process of wear.

Local sportsmen often see two additional species on quail they have bagged. These are the so-called Quail Louse Flies (*Lynchia hirsuta* and *Stilbometopa impressa*). They are much larger (3/16 to 1/4 inch body length) than the deer louse flies and much more rapid in their movements. They move with equal facility forward, backward or sideways through and over the feathers. *Lynchia americana* is yet another species which may infest domestic pigeons. Other species, as well as the above, may be found on the wild birds in the Basin; *Pseudolynchia canariensis* is the common form on domestic pigeons.

All louse flies are blood suckers, although none feed regularly on man. They may transmit disease between wild animals but not to and between humans.

Development of these flies is of a special type: The larvae are not free-living but mature within the body of the female parent. When the puparium is formed the female deposits it on the host, from whence it shortly falls off onto the ground.

REFERENCES: Hare, J. 1953. Bionomics of *Lipoptena depressa* (Say), the common louse fly of deer in Western North America (Diptera: Hippoboscidae). Microentomology, vol. 18, pp. 38-51.

Herman, C. 1945. Hippoboscid flies as parasites of game animals in California. Calif. Fish Game, vol. 31, pp. 16-25.

Tarshis, I. 1958. New data on the biology of *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta*, Ferris (Diptera: Hippoboscidae). Entomol. Soc. Amer., Ann., vol. 51, pp. 95-105.

Fleas
Order SIPHONAPTERA

Figure 165. A typical flea, the Cat Flea.

The scientific name of this order refers to the feeding habits (*siphon*-sucking) of these insects and their wingless condition (*a*-without; *pteron*-wing).Fleas probably descended from primitive blood-sucking flies which lives in mammal or bird nests and had little use for wings in their parasitic way of life. All members of the order are ecto-parasitic on warm-blooded vertebrates and show peculiar structures adapting them to an environment of fur or feathers. Of these, especially notable are the combs of flattened spines on the head and prothorax which, in conjunction with their streamlined, compressed bodies, facilitate the flea's progress through the host's pelt. Anyone who has tried to catch fleas on his dog or cat or to hold onto them will know who quick and "slippery" they can be. Enlarged claws at the tips of the legs also enable the insect to grasp and hold onto the host.

Fleas are important pests of man and his pets because of the annoyance caused by their bites. Although some species are capable of transmitting diseases, allergic responses to flea bites are by far the most common local reason for complaints. The species involved most often in cases of flea bites is the Cat Flea. Cat Fleas may bite anywhere on the body but, since they are usually found on the floor or ground, most attack the lower legs.

Infestations most often appear in homes with a cat or dog, but human bites are seldom experienced until the animal has been away from the premises for a prolonged period. Many new fleas will have matured in this time and adult fleas already present will have been without their normal food source for a long time. Active and hungry, they greedily feast on the nearest warm-blooded animals—people. Adult fleas can survive for long periods, up to 18 months, without food. Occasionally an infestation may be traced to a stray animal which has had a litter or has died under the house.

Fleas breed in largest numbers under a pet's bedding area. The larvae hatch from eggs which have become lodged in floor cracks and crevices, bedding of the host, furniture and in the soil. They feed on bits of organic debris, including partially digested blood dropped by adult fleas. Pupation occurs in a loose silken cocoon to which adheres particles of dust or sand, providing a degree of camouflage.

Some species breed in sandy areas and possibly have contributed to the common term "sand flea," used especially to explain bites experienced by bathers on the beach. Species of terrestrial amphipod crustaceans (*Orchestia* and *Orchestoidea*), seen scurrying nearby, are often blamed by lay persons unaware that these animals do not bite but feed only on organic debris. This unjustified incrimination is reinforced by the fact that these "beach fleas" or "hoppers" have a compressed flea shape and hop about in flealike fashion. Probably Stable Flies, punkies and mosquitoes are the real culprits in most of these cases.

As already mentioned, fleas can transmit infectious diseases, most notoriously Bubonic Plague (caused by the bacterium *Pasteurella pestis*). Plague of rodent-flea origin occasionally crops up in California and is always a potential threat to our health. The State Bureau of Vector Control (under the Department of Public Health) maintains a constant vigil on the distribution of fleas and plague organisms throughout the state and enacts swift controls in the event of an outbreak.

Murine Typhus is another disease which passes from host to host by means of fleas and occurs locally in certain areas. The chief vector is probably the Mouse Flea (*Leptopsylla segnis*).

A list of the most common fleas and their hosts in the Los Angeles Basin follows:

1. Cat Flea (*Ctenocephalides felis*).
Domestic; very common on cats and dogs; our most abundant species. (The Dog Flea [*C. canis*], also found on both cats and dogs, is very rare in our area).

2. Stick-tight Flea (*Echidnophaga gallinacea*). Wild on ground squirrels and wood rats; domestic on rats and fowl. Adults partly bury their head in the host's flesh when feeding.

3. Human Flea (*Pulex irritans*). This species, so common in other metropolitan areas, is presently very rare or non-existant in the Basin. The closely related *P. simulans*, a flea of wild deer and other mammals, may occasionally attack humans in wild areas and be mistaken for the Human Flea.

4. Oriental Rat Flea (*Xenopsylla cheopis*). Domestic; on rats.

5. Mouse Flea (*Leptopsylla segnis*). On domestic rats and mice.

6. Ground Squirrel Flea (*Diamanus montanus*). On ground squirrels.

7. Northern Rat Flea (*Nosopsyllus fasciatus*). Domestic; on rats.

8. Wild Mouse Flea (*Malaraeus telchinus*). Wild; on various species of field mice and wood rats.

9. Rabbit Flea (*Cediopsylla inaequalis*). On cottontail and jack rabbits.

REFERENCES: Hubbard, C. 1947. *Fleas of western North America*. Iowa State Coll. Press, Ames.

Keh, B. and A. Barnes. 1961. *Fleas as household pests in California*. Calif. Vector Views, vol. 8, pp. 55-58.

Beetles
Order COLEOPTERA

The most distinctive feature of this order is the thickened, hard or leathery fore wings (called "elytra"), covering and protecting the hind wings and usually meeting in a straight line down the back. Only the hind wings are used for flight, the elytra being useless for this purpose.

Weevils, thought by many people to comprise a special category of insects, are actually beetles, having the head greatly elongated into a snout.

REFERENCES: Arnett, R. 1960-62. The Beetles of the United States. Catholic Univ. Press, Washington, D.C.

Jaques, H. 1951. How to Know the Beetles. W. C. Brown Co., Dubuque.

Nearly a quarter of a million kinds of beetles are known, the largest order of living organisms. They vary tremendously in size, structure and biology and are found almost everywhere. Only a few of the most conspicuous species in the Basin can be discussed here:

Tiger Beetles
Family Cicindelidae

Oregon Tiger Beetle
(*Cicindela oregona*)

Figure 166. Oregon Tiger Beetle.

This common beetle occurs almost everywhere there are sandy flats or sand bars near water, a fact due to the habit of the larvae of living in small, vertical holes in moist, compact, sandy soil. These conditions are found in arroyos and by our large streams, ponds, rivers—especially where they empty into the sea—and at the seashore itself.

The larvae have a large flat head which they use to block the entrance of their burrows. They may also be recognized by a conspicuous hump on the fifth abdominal segment.

Both larvae and adults are predaceous. The former snatch small prey which happen to stray close to their burrows. The agile, fast-flying beetles hunt and capture other small creatures which they kill and hold with their powerful sickle-shaped mandibles. They are most active in the hot sunshine during the middle hours of late spring and summer days. Their flight pattern and general appearance resemble those of flies for which they may be mistaken.

The Oregon Tiger Beetle is a dull colored member of an otherwise brilliantly marked group, although some parts of the undersurface reflect iridescent green and bronzy hues in the proper light. The upper surface is somber brown with irregular yellow splotches on the wing covers.

Ground Beetles
Family Carabidae

Several species and genera of long-legged, fast-running beetles, known collectively as Ground Beetles, are common in the Basin, especially under stones, boards or other objects lying on damp ground. Hiding by day where it is dark and damp, they typically venture forth at night in search of the small soft-bodied invertebrates which are their prey. Both adults and larvae are predaceous and live in the same habitats.

Figure 167. Common ground beetles: a.—*Pterostichus* and b.—*Platynus*.

The majority of our forms are small or medium-sized, totally black in color and generally so similar in appearance that they are indistinguishable except to the specialist. Most of these belong to the genera *Pterostichus, Calathus,* and *Platynus.* Several others, however, as those that follow, identify themselves with characteristic forms, colors or habits:

Snail Eaters
(*Scaphinotus*)

The inflated, elliptical wing covers (hind body region much broader than the prothorax) and extra long mandibles and legs are distinctive for this genus. Our two uncommon species, *cristatus*

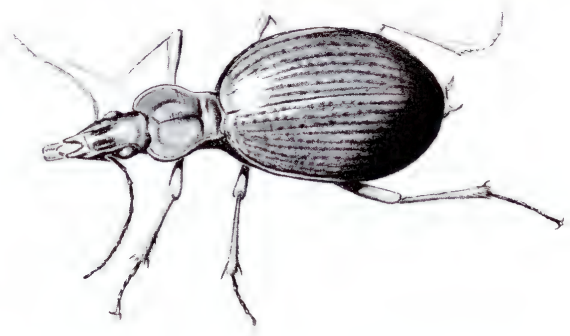


Figure 168. Snail Eater *(Scaphinotus punctatus).*

and *punctatus* are black and, like all their close relatives, prey on slugs, snails, and other insects.

REFERENCE: Noonan, G. 1967. Observations on the ecology and feeding habits of adult *Scaphinotus punctatus* LeConte (Coleoptera: Carabidae). Pan-Pacific Entomol., vol. 43, pp. 21-23.

Common Calosoma
(*Calosoma semilaeve*)

Figure 169. Common Calosoma.

During the spring this beetle may be so common as to constitute a pest. The adults are large (about 1 inch long) and run free during the day, not being confined to burrows or cavities under objects on the ground. They often enter homes and, when disturbed, emit a disagreeable odor which smells something like burnt rubber electrical insulation. Because of their size, black color, and activeness they are sometimes mistaken for the Oriental Cockroach.

Caterpillars, especially cutworms and wireworms, are the favorite prey of both adults and larvae.

Bombardier Beetles
(*Brachinus*)

Figure 170. Bombardier Beetle.

These smallish ground beetles (less than ½ inch long) are easily recognized among the ground-dwelling beetles by their dark blue or brown wing covers and contrasting red head and prothorax. They are never found far from water; by streams, lakes and in marshy areas, and may be quite abundant under stones and other objects on moist ground.

These beetles are best known for their ability, when alarmed, to forcibly eject a liquid (composed partly of nitrogen and benzoquinones) from glands at the rear end of the body. This liquid volatilizes instantly upon contact with the air, generating a small puff of "smoke" accompanied by an audible popping or crackling sound. If this liquid touches human skin the skin will burn for an instant and then turn dark brown for several days, eventually fading to normal color. Enemies of *Brachinus* (birds, insects, skunks, etc.) no doubt will be affected in much the same manner and will not "forget" the uncomfortable experience.

The larvae of some *Brachinus* have been observed to prey on the larvae of aquatic beetles of the family Hydrophilidae (*Berosus*). This habit is probably general for the genus. Larval development may be extremely rapid, only one or two days being required between hatching of the egg and pupation.

REFERENCE: Erwin, T. 1965. A revision of *Brachinus* of North America: Part I. The California species. Coleopterists' Bull., vol. 19, pp. 1-19.

False Bombardiers
(*Chlaenius*)

Figure 171. False bombardier beetle.

These are medium-sized (a little over ½ inch long) and usually dark, steely blue in color with reddish brown legs. When disturbed they give off a disagreeable odor resembling that of fresh leather. One species (*sericeus*) has a bright, metallic green form. It is common along margins of ponds and streams.

Fireflies
Family Lampyridae

Pink Glowworm
(*Microphotus angustus*)

Figure 172. Pink Glowworm, female.

Easterners and Mid-westerners who have moved to Los Angeles often remark on the absence of "fireflies." There are no southern California beetles of the firefly family (Lampyridae) which emit a bright, flashing light like their eastern relatives. However, the female Pink Glowworm, and occasionally the male, gives off a continuous luminescent glow. The adult male has the usual firefly beetle form but the female is wingless and elongate like the larva (termed "larviform").

The males are not seen as often as the females. The latter is somewhat common in the late spring and summer in the foothill canyons. Often found under stones lying on leaf mold in grassy areas, they are easily recognized by the pink margins of the otherwise black, flattened segments.

Aquatic and Semiaquatic Coleoptera
Water Beetles

The aquatic and semiaquatic bugs (Hemiptera) have already been introduced. A corresponding group of beetles, belonging to several families, has members living in, on, or near water:

Aquatic
Water Scavenger Beetles
Family Hydrophilidae

The water loving species of this family most commonly inhabit marshy places, weedy, shallow ponds and stream pools or flooded areas with grass growing out of the water. The larvae are found in similar places, usually among algae and weeds or in marginal plant debris. Adults are herbivorous, the larvae mainly carnivorous, feeding on one another and other small aquatic invertebrates.

Members of this family are often confused with the predaceous water beetles (Dytiscidae). Several characteristics which distinguish them, however, are tabulated below:

Hydrophilidae
- Flat or "keeled" on the underside
- Poor swimmers: move legs alternately (running motion)
- Take in air at surface with anterior end of body, tail down

Dytiscidae
- Underside broadly rounded or convex
- Good swimmers: move hind legs in unison (oarlike motion)
- Take in air at surface with posterior end of body, tail up

Of the many species of water scavenger beetles in the Basin, the following are noteworthy:

Giant Water Scavenger
(*Hydrophilus triangularis*)

Figure 173. Giant Water Scavenger.

Easily recognized by its large size (length nearly 1½ inches), this species is not common in the Basin but, when seen, attracts attention. It is a strong flier and occasionally comes to lights in warm weather.

Elliptic Water Scavengers
(*Tropisternus*)

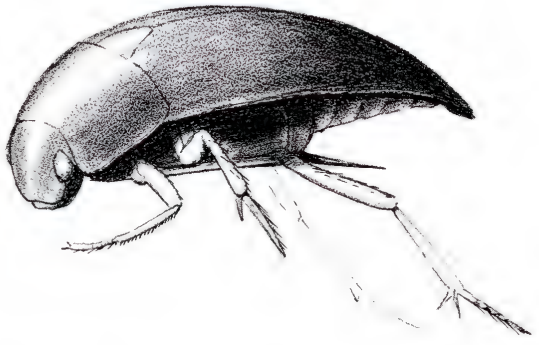


Figure 174. Elliptic Water Scavenger.

These water scavenger beetles are similar in shape to the foregoing but much smaller (less than ½ inch long) and considerably more common.

They are easily recognized by the strongly convex profile and the long, sharp keel on the underside.

Semiaquatic

Whirligig Beetles
Family Gyrinidae
(*Gyrinus*)

Figure 175. Whirligig beetles.

The whirligigs live up to their name as they wildly whirl and gyrate in schools on the surfaces of small ponds and quiet stream pools. Structurally, they are separated from other water beetles by their extra long front legs and divided compound eyes; each eye is divided into two widely separated parts (so that the beetle appears to have four eyes), allowing vision into the air and the water simultaneously.

Though normally living on the surface film, the adults dive readily and can take flight after crawling out of the water. Their food consists of organic material scavenged from the water surface. Long and slender and bearing several pairs of lateral featherlike gills, the larvae live on the bottom and prey on other small aquatic insects.

All our species are small (slightly less than ¼ inch long) and shiny black.

Rove Beetles
Family Staphylinidae

Devil's Coach Horse
(*Ocypus olens*)

Members of this family are characterized by short wing covers; most of the abdomen is exposed

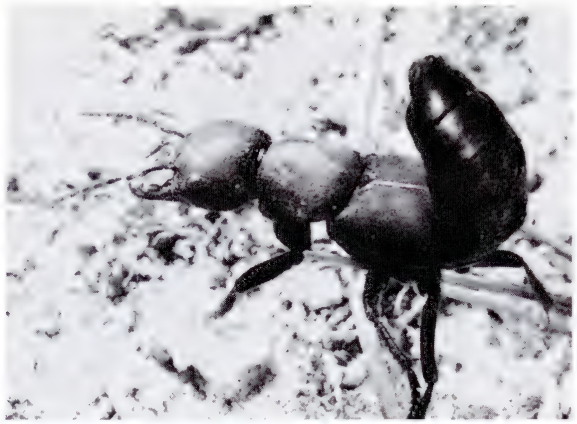


Figure 176. Devil's Coach Horse.

and freely movable. When alarmed, this beetle opens its formidable jaws and rears its abdomen, moving it threateningly, as if attempting to sting. Though there is no sting, the action is deceptive. A malodorous yellowish fluid may be emitted from two cream-colored, eversible glands at the tip of the abdomen, a habit giving the beetle its name "olens," meaning "stinking."

Both the adults which appear in September and October, and larvae, are voracious predators, feeding on other insects and small invertebrates, especially sowbugs. They will also eat carrion.

The species is native to Europe but was apparently introduced into California many years ago, possibly in the earthen ballast of sailing ships.

Click Beetles
Family Elateridae

There are many species of these slender, drably colored beetles living in the Basin. All of them have a special mechanism on the ventral side between the prothorax and mesothorax which, when snapped sharply closed, emits an audible clicking sound and arches violently. A click beetle, stranded on its back, employs this means to flip itself into the air. With luck, it lands on its feet the first try and ambles off; more often several attempts are necessary for the insect to right itself.

In addition to their acrobatic behavior, click beetles can be recognized by their elongate shape and the sharp angles at the outer corners of the prothorax. The larvae, called wireworms, live primarily in the soil, where they feed on plant roots, tubers and stems.

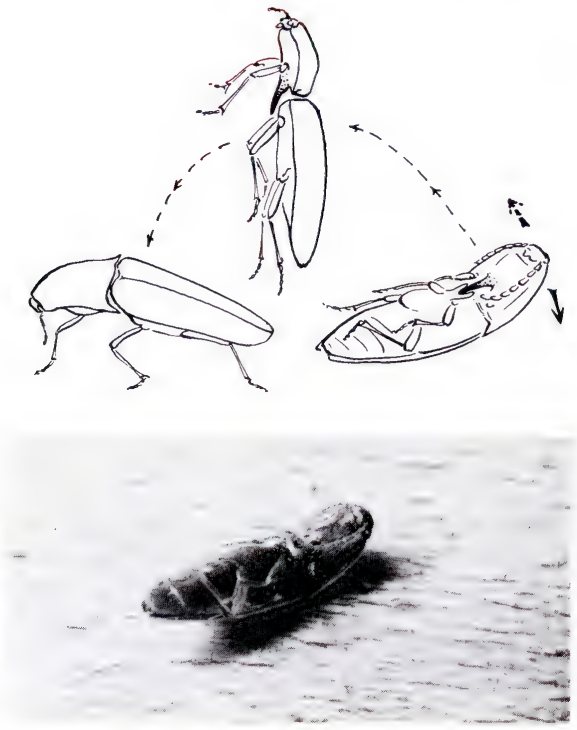


Figure 177. Click beetle

Pantry Beetles and Bookworms

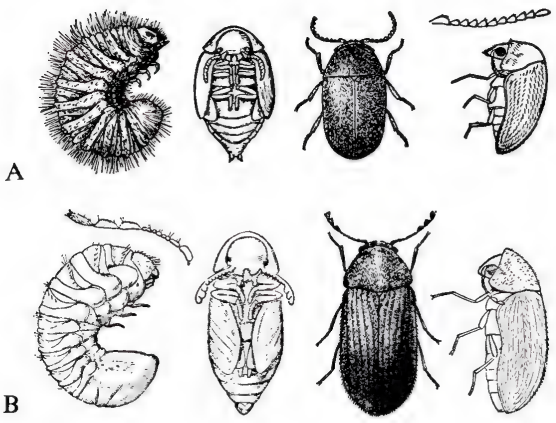


Figure 178. Pantry beetles (larva, pupa and adults): a.—Drug Store Beetle, b.—Cigarette Beetle. (From Back, E. and R. Cotton. 1938. U.S. Dept. Agr., Farmers' Bull. 1260.)

Several species of beetles infest dried food products like their cohorts, the pantry moths. Though the larvae rarely consume an appreciable quantity of the food, their presence alone is sufficient to render it unpalatable.

Pantry beetles share similar habits. They are likely to be found in all kinds of dry, organic material used by humans as food. This includes such common foods as dry breakfast cereal, rice, oats, wheat, peas, candy, spices, dried fruit, noodles and spaghetti, etc., and materials not usually thought of as food, including tobacco, red pepper, drugs, herbs, and even certain types of upholstery stuffing.

The principal offenders in this category in the Basin are listed and characterized below. Often the layman refers to all these forms as "weevils;" technically, however, the only true weevil on the following list is the last species, the others belonging to other beetle families:

Family Anobiidae

1. Drug Store Beetle (*Stegobium panaceum*). Enlarged prothoracic shield covering much of the head dorsally; elongate, oval shape in side view; antenna clubbed. Larva bare, C-shaped.

2. Cigarette Beetle (*Lasioderma serricorne*). Enlarged prothoracic shield as in above species but with triangular shape in side view; antenna serrate. Larva hairy, C-shaped.

Family Sylvanidae

3. Saw-toothed Grain Beetle (*Oryzaephilus surinamensis*). Very tiny (⅛ inch or less). Elongate and slender; margins of prothorax with teeth; larva elongate, straight, pale-colored.

Family Tenebrionidae

4. Flour Beetles (*Tribolium* species). Moderately small (1/8 - 3/16 inch long). Body elongate with smooth margins on prothorax; larva elongate, pigmented.

5. Mealworms (*Tenebrio obscurus*). Large (¾ - 1 inch long). Body elongate with smooth margins on prothorax; larva elongate, pigmented—these are the "Li Cut" worms familiar as bait to the fisherman.

Family Curculionidae

6. Grain Weevils (*Sitophilus* species). Very small (1/16 inch long). True weevils with elongate snout; larva an obese, pale grub without obvious legs.

The wormlike larvae of certain of the above species, notably the Drug Store Beetle and Cigarette Beetle, include paper in their diets. These and a few additional ones may burrow themselves within the pages of books, consuming and ruining

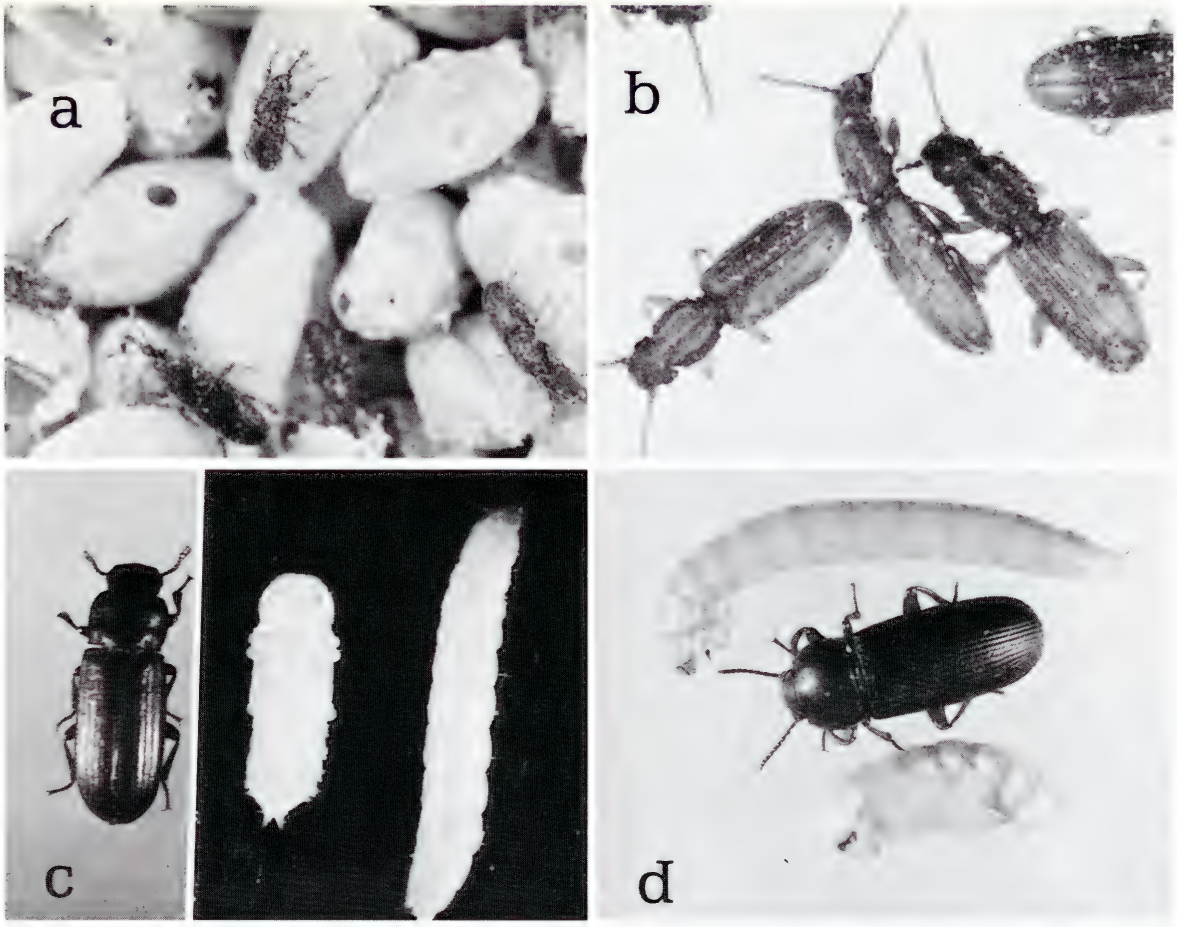


Figure 179. Pantry beetles: a.—Grain weevil, b.—Sawtoothed Grain Beetle, c.—Floor Beetle, d.—Mealworm.

them. From this arose the early, satirical comparison of a learned or studious person to a "bookworm." According to Back, the expression is attributable to Philippus of Thessalonica in the first century A.D.

Fortunately, bookworms in the United States generally confine their ravages to the leather and cardboard of the binding and cover. Damage to pages deep within the book is common only in damp, tropical climates.

A source of wonder to housewives is how these pests can appear in a package of tightly sealed, dried food. Commonly, entry is by way of minute imperfections in the seal, but some species may bore through paper and cardboard containers to get at the contents. In other cases, infestation occurred in the bulk-stored grain in railroad cars, warehouse and at other stops along the processing line.

REFERENCES: U. S. Dept. Agriculture. 1953. Farmers' Bull. No. 1260.
Back, E. 1939. Bookworms. Smithsonian Institution, Annual Report for 1939.

Ladybird Beetles

Family Coccinellidae

Immortalized in the nursery rhyme, "Ladybird, ladybird, fly away home. . . ." this group of beetles is known to everyone and needs no description. Most kinds, both as adults and larvae, are voracious predators of other small, soft bodied insects, particularly aphids and scale insects, and therefore are beneficial in the garden and on the farm.

REFERENCES: Doutt, R. 1958. Vice, virtue and the Vedalia. Entomol. Soc. Amer., Bull., vol. 4, pp. 119-123.
Hagen, K. 1962. Biology and ecology of predaceous Coccinellidae. Annu. Rev. Entomol., vol. 7, pp. 289-326.

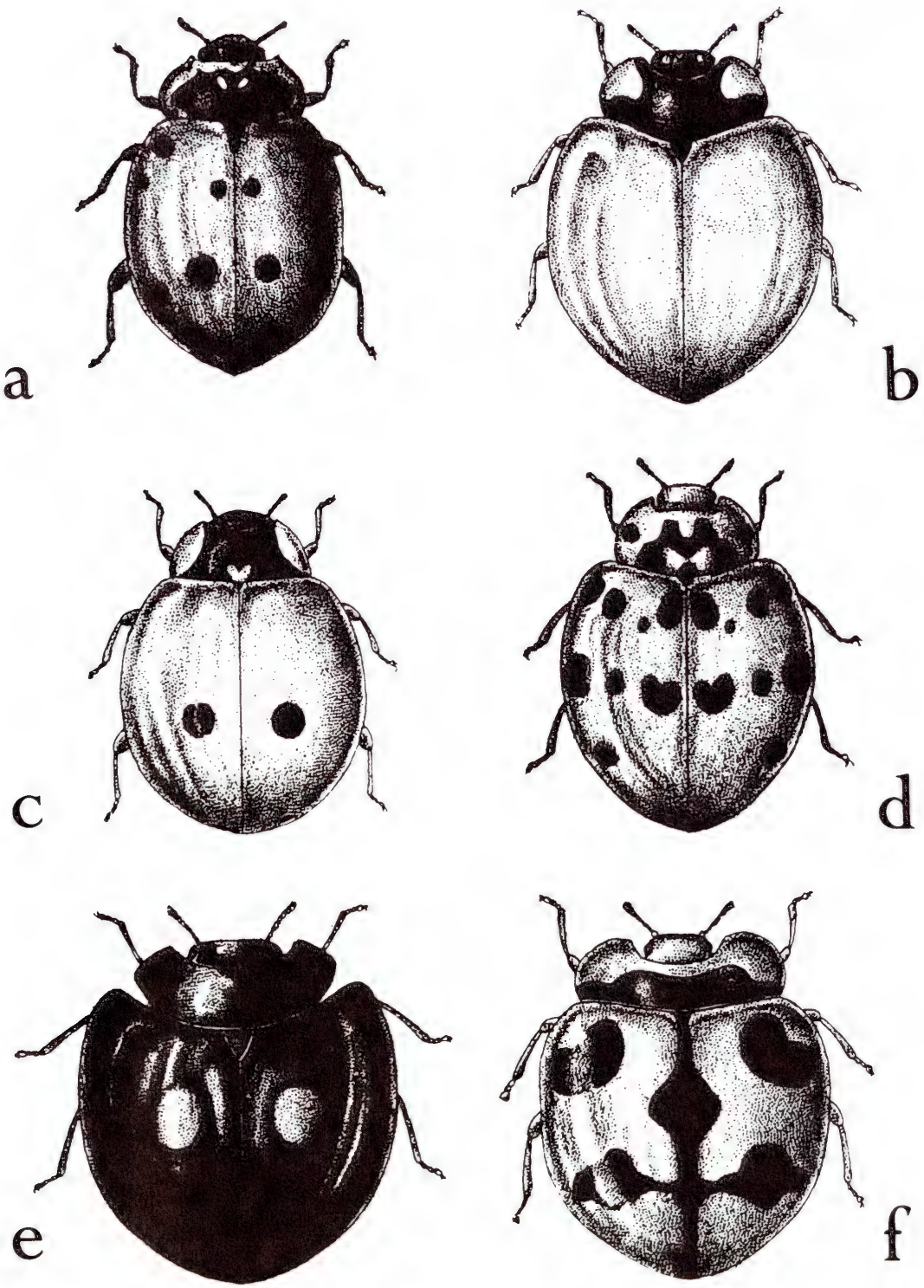


Figure 180. Ladybird Beetles: a.—Convergent Lady Beetle, b.—California Ladybird Beetle, c.—Two-spotted Lady Beetle, d.—Ashy gray Ladybird, e.—Two-stabbed Ladybird, f.—The Vedalia. (From Papp, C. 1957. Bull. So. Calif. Acad. Sci., vol. 56:156)

Our commonest local species, grouped according to their color patterns, are listed below. The first six feed primarily on aphids.

A. Red with numerous small black spots, or solid red.

1. Convergent Lady Beetle (*Hippodamia convergens*).

The species most often seen in the garden. Usually the black spots are present but a solid, blood-red variant is common and hardly distinguishable from the California Ladybird described below.

It is by far the most important ladybird involved in the biological control of aphids. During the late summer and fall, the adults congregate in great masses in mountain canyons and other cool, protected places. Here they hibernate up to nine months, frequently buried beneath the snow, until the first warm spring days when they move back to the valleys.

The larva is elongate, black or gray in general color, with indistinct orange spots on the back. Because of its shape and voracity it has been likened to a tiny alligator. The pupae are red and black.

2. Five-spotted Ladybird Beetle (*Hippodamia quinquesignata*).

This species is closely related to the foregoing and, in all its variations, practically indistinguishable from it.

3. California Ladybird Beetle (*Coccinella californica*).

The adults of this species are almost identical superficially to unmarked individuals of the preceding two, being only slightly larger and more oval in shape.

B. Red with two large, black spots.

4. Two-spotted Lady Beetle (*Adalia bipunctata*).

C. Gray with numerous small black spots.

5. Ashy Gray Ladybird (*Olla abdominalis*).

D. Black with two large, red spots.

6. Two-stabbed Ladybird (*Chilocorus bivulnerus*).

E. Black in the middle, reddish front and rear.

7. Mealybug Destroyer (*Cryptolaemus montrouzieri*).

This is an introduced species. The larvae are white and covered with waxy excrescences, giving them an appearance similar to the mealybugs upon which they feed.

Figure 181. Convergent Lady Beetle, a.—adult, b.—larvae.

F. Black with large E-shaped red markings back to back on the wing covers.

8. The Vedalia (*Rodolia cardinalis*).

This is the famous beetle imported from Australia to control the Cottony-cushion scale, which severely threatened the southern California citrus industry around the turn of the century.

Darkling Beetles
Family Tenebrionidae

Ironclad Beetle
(*Phloeodes pustulosus*)

Figure 182. Ironclad Beetle.

This beetle derives its name from its extremely hard outer shell; it even may be difficult to pierce it with a pin when mounting a specimen. The species is about ¾ - 1 inch long and dull gray-black in color. The surface textures of the wing covers and prothorax is very rough. Adult Ironclads are fairly abundant locally under the loose bark of dead trees, especially oaks.

Stink Beetles
(*Eleodes* species)

Several species of medium to large (1 to 1¼ inch long), smooth, shiny, black beetles belonging to this genus are common in the Basin, primarily in the hilly areas. These conspicuous beetles are usually encountered as they amble along the ground; when their wandering is interrupted, they stand on their heads and point their rear ends disdainfully into the air. For this headstanding habit, they are sometimes called "acrobat beetles." Individuals may also be found under stones and loose tree bark where the long, cylindrical larvae often live. The latter are nut-brown in color and prominently jointed; they feed on the seeds, roots and underground parts of many kinds of herbaceous plants. The adults are general feeders.

Figure 183. Stink Beetle, in threat pose.

Eggs are laid in the soil in the spring.

Adults emit a disagreeable, though not strong, odor when handled. The wing covers are fused along the mid-line making it impossible for the beetle to fly.

Soldier Beetles
Family Cantharidae

Brown Leatherwing
(*Cantharis consors*)

As in all members of its family, this species has soft wing covers—in this species they are

Figure 184. Brown Leatherwing.

medium brown, while the prothorax and legs are orange. Total length of the beetle is about 5/8 to 3/4 inch.

Adults frequently come to porch lights in the late spring. Practically nothing is known of the habits of either adults or larvae. Probably both are ground dwellers living among litter where they prey on other insects.

Scarab Beetles
(Family Scarabaeidae)

This beetle family contains the famous Sacred Scarab (*Scarabeus sacer*) of ancient Egypt. The species was venerated in the religion of this civilization: effigies figured in the hieroglyphic script and were common in jewelry while scarab images replaced the hearts of high ranking mummies.

The family is a very large one. Its varied members, including june beetles, chafers, and dung rollers, have in common antennae with a terminal club composed of leaflike plates which may be opened and closed. The larvae of most of our species are grublike root feeders. Many genera and species occur in the Basin; only the following few can be mentioned:

Rain Beetles
(*Pleocoma* species)

The first measurable late fall or winter rains stimulate the adults of this genus of scarab beetles to emerge from their subterranean burrows, in which they have lain as pupae for more than a month. In some species a soaking rain of several inches is needed to initiate activity, but higher elevation forms will often fly within a few minutes following the onset of the first rain. The males seem to emerge in response to the rain, and may be attracted to light, congregating during a drizzle or downpour around restaurants or dwellings in the foothill and canyon areas. When searching for the burrows of the flightless female beetles, the males fly in slow sweeping patterns low over the ground and brush. The two major periods of flight and mating activity for most species occur shortly before dark and again before daybreak, with occasional males continuing to fly throughout the night or at midday. Other species will fly actively as long as it is raining, no matter what the time of day.

Between flights the males may re-enter the ground, digging shallow (about 4 inches deep) burrows with their shovellike head and strong fore legs, or hide beneath leaves and debris. The females seldom are found outside their burrows, which may extend as much as four to six feet into the soil.

Figure 185. A rain beetle (*Pleocoma*): a.—adult male, b.—larva.

The males apparently locate the burrows of the females by detecting a strong scent she puts into the air, and enter her burrow to copulate. After copulation, the female plugs her burrow with pulverized soil and digs deep into the ground. Her eggs do not mature until the following spring or early summer. She lays them in a spiral at the base of her burrow, packed tightly with fine soil. The newly hatched larvae shed their skin and then move through the soil in search of their food.

The life cycle may last as long as 10 or 12 years, with the larvae feeding on the roots of varied kinds of plants, usually hardwood shrubs or trees, particularly oaks and conifers. The mouthparts of the adults are atrophied and useless for feeding.

The two most common species in the Los Angeles area are *P. puncticollis* and *australis*. The former is shiny black with dense black hair on the undersurface, and is found primarily in the Santa Monica Mountains where it is strongly attracted to light at night. The latter is black also, but the hair is light reddish; it occurs in the foothills of the San Gabriel Mountains. Two less frequently encountered species, *P. badia* and *hirsuta*, are also found in the San Gabriel Mountains. The former is wholly light reddish brown with translucent wing covers, while *hirsuta* resembles *australis* in color but has seven leftlets in the antennal club instead of four.

REFERENCES: Hovore, F. 1971. A new *Pleocoma* from southern California with notes on additional species. Pan-Pacific Entomol., vol. 47, pp. 193-201.

Smith, R. and R. Potts. 1945. Biological notes on *Pleocoma hirticollis vandykei* Linsley. Pan-Pacific Entomol., vol. 21, pp. 115-118.

Stein, W. 1963. *Pleocoma* larvae, root feeders in western forests. Northwest Sci., vol. 37, pp. 126-143.

Common June Beetles
(*Thyce, Serica, Polyphaga, Phobetus* and *Paracotalpa*)

Figure 187. Common June beetle *(Paracotalpa).*

Varied in size from ¼ to ¾ inch long, these are mostly montonously dark to light brown beetles although some of the last genus are more vividly colored with reddish or greenish hues. There are many species and they are most often encountered on warm summer evenings when large numbers sometimes come to porch or other outdoor lights.

Ten-lined June Beetle
(*Polyphylla*)

Figure 186. Ten-lined June Beetle.

These are large (1 to 1½ inch long) scarabs whose wing covers have conspicuous, longitudinal, white stripes. They are frequently attracted to light at night.

Fig Beetle
(*Cotinus texana*)

Figure 188. Fig Beetle.

This scarab occurs only sporadically in the Basin, although it may be locally abundant in the few remaining fruit orchards or in suburban neighborhoods where backyard fruit trees grow.

Originally native to Arizona and New Mexico, it appears to be spreading gradually westward and has become noticeable in Los Angeles only in the last few years.

The adults feed on a wide variety of fruits including cactus fruit (original host ?), figs, peaches and grapes. The beetle is easily recognized by its large size (¾ to 1⅛ inches in length) and general velvety, olive-green color with contrasting brownish yellow marginal bands.

The eggs are laid in the ground during the adult activity period of late summer to early fall. The larvae tunnel in the soil but emerge periodically to feed on surface organic matter under cover of litter. Development commonly occurs beneath manure piles and haystacks.

REFERENCE: Nichol, A. 1935. A study of the fig beetle, *Cotinus texana*. Ariz. Agr. Exp. Sta., Tech. Bull. 55: 154-198.

Dermestid Beetles
Family Dermestidae
Carpet Beetles

Figure 189. Carpet beetle *(Anthrenus)*, adults and larvae.

The larvae of these beetles are more often seen than the adults. The former are small, brownish elongate or oval creatures with rows of stiff, short hairs on the body segments and longer tufts projecting from the rear and sides. Frequently only the cast skins are found.

Preferring dark, undisturbed places and feeding on all sorts of natural textiles, the larvae may do great damage in the home.

The adults, which live on flower pollen and nectar, are small (⅛ inch or less long), oval beetles with short legs, entirely black in color or variegated black, brownish and white.

Three genera are most common:

1. *Attagenus.*

Adult solid dark brown or black, shiny. Larva slender, about four times as long as wide, with short stiff hairs.

2. *Anthrenus.*

Adult with a conspicuous mottled pattern on the back, red, white or black splotched. Larva stout, less than three times as long as wide, with long hairs and two tufts at the posterior end.

3. *Trogoderma.*

Adult solid black, with dull pubescence forming irregular light markings. Larva stout, about three times as long as wide, with long hairs but without terminal tufts.

Includes the very important Khapra Beetle (*T. granarium*) responsible for great losses of stored grain and flour. It has been irradicated from California but its re-entry is a constant threat.

Commercial-wood Boring Beetles

Wood used in the manufacture of furniture, picture frames, tool handles, boxes, etc., as well as in the construction of homes, is attacked by several types of beetles. Under natural conditions these beetles breed in dead tree branches, fallen twigs, and other cellulose material. The larvae cause the most damage as they bore through the interior of the wood, but emerging adults also make unsightly holes in the surface. Certain beetle ridden wood—"worm wood"—is considered fashionable by some people, however, and commands a high price. In this case these beetles may create an economically desirable product.

The principal types of wood-boring beetles in the Basin are as follows:

Family Bostrichidae
Stout's Hardwood Borer
(*Polycaon stouti*)

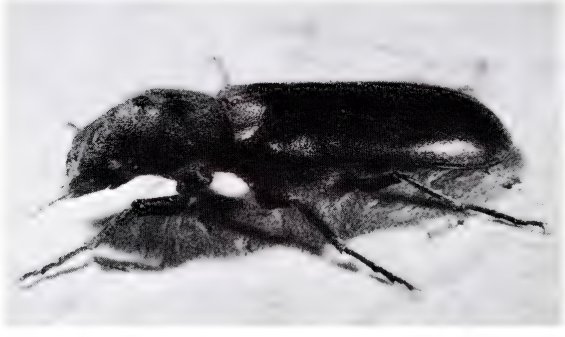


Figure 190. Stout's Hardwood Borer.

Adults of this ¾ inch long, black beetle may appear in unlikely places, such as in the hallways and rooms of new buildings, in warehouses, and in homes. Their occurrence is explained by their breeding habits: the larvae are wood borers, feeding within various hard woods such as oak, California Laurel, alder, maple, etc. Adults may emerge from these woods when used in construction, such as for slats used behind acoustic ceiling tiles, boxes, storage racks, and even finished table tops.

Family Lyctidae
Powder-post Beetles
(*Lyctus* species)

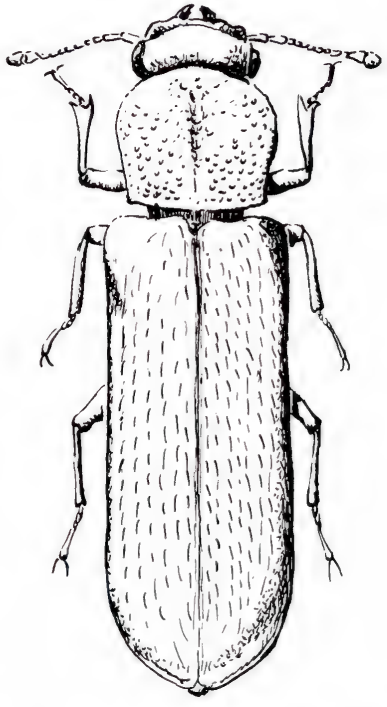


Figure 191. Powder-post Beetle *(Lyctus planicollis).*

Powder-post Beetles are so named because their borings reduce the interior of seasoned hardwoods to a fine dust. Oak, ash, hickory, maple, and walnut are preferred.

The adults are small, (¼ inch long), elongate, brown-black beetles. The females often lay their eggs in pores on the surface of the same wood from which they emerged. Hence the same wood may be infested repeatedly.

REFERENCE: Gerberg, E. 1957. A revision of the new world species of powder-post beetles belonging to the family Lyctidae. U.S. Dept. Agr., Tech. Bull. 1157.

Family Anobiidae

Furniture Beetle

(*Anobium punctatum*)

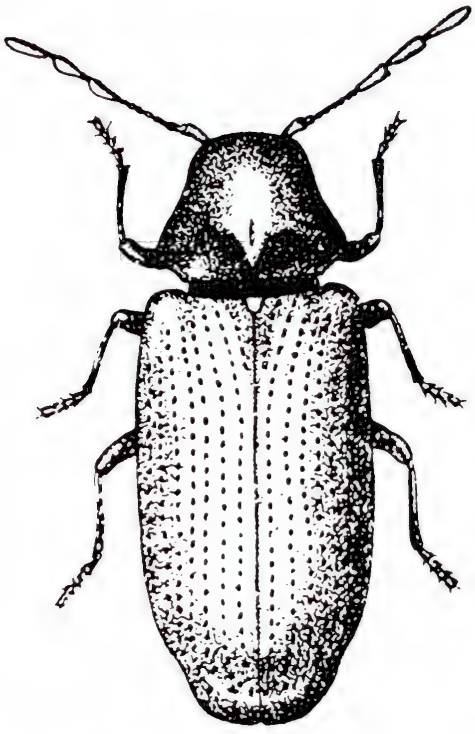


Figure 192. Furniture Beetle. (From Fisher. 1940. For. Prod. Res. Bull. 19:25)

This species principally attacks the sapwood of conifers as well as hardwoods. The larvae seem to prefer old, thoroughly dry wood and therefore act as prime destroyers of antique furniture.

Long-horned Beetles

Family Cerambycidae

Very long antennae typify these beetles and give them their vernacular name. The larvae, called roundheaded borers, are wood-feeding. Most of our species are found only in dead, natural woods, usually logs in mountain areas, and do not become pests of houses or furniture.

Two species are conspicuous in our area, mainly because of their large size. They are mostly mountain dwellers and not regular residents of the Basin, but are included because they occasionally enter our area on the northern fringes or make themselves conspicuous to campers visiting the San Gabriel or San Bernardino Mountains. Both are very large, dark brown beetles with long antennae whose larvae burrow in the dead and decomposing wood of deciduous and coniferous trees.

Pine Sawyer

(*Ergates spiculatus*)

Figure 193. Pine Sawyer.

This is the largest local beetle, (1½ - 2¼ inches long). The lateral margins of the prothorax are armed with many very small, sharp teeth or spines. The larvae are very large, pale grubs (up to 2½ inches in length), which burrow in the wood of dead or felled coniferous trees. They also feed in fallen logs, stumps, and telephone poles. Though similar to those of the following form, Pine Sawyer larvae are characterized by four blunt teeth on the front of the head.

The females are attracted to lights. Campers in pine flats in the neighboring mountains are frequently startled when these beetles loudly buzz into their lanterns on warm summer evenings. Adults are active from July to September.

California Prionus

(*Prionus californicus*)

Adults of this beetle are similar to the preceding in size and coloring but have a slightly broader

body and the teeth of the lateral margins of the prothorax are coarse and only three in number. The antennal segments of the male are conspicuously lobed.

Figure 194. California Prionus, male.

The mature larva is about three inches long and ¾ inch in diameter. There are no teeth on the front of the head. As a root borer in living native trees the immatures frequently are injurious to oaks, madrone, and cottonwoods, as well as to various fruit trees. Pupation occurs in an underground cell near the roots of the host or in the wood itself.

Adults emerge in early summer and are nocturnal or crepuscular fliers, readily attracted to lights.

Milkweed Borer
(*Tetraopes basalis*)

Figure 195. Milkweed Borer.

Wherever milkweed (*Asclepias*) grows this long-horned beetle may be found congregating on the leaves and flowers. Individuals are entirely dull red in color with the exception of a pattern of black spots, usually one behind each eye, four in a square on the prothorax, and two diagonally placed on each wing cover; there is an additional spot also at the forward lateral corner of the wing cover.

When abundant, these beetles are somewhat gregarious with numerous individuals occupying the same plant. They are not usually active and are not apt to fly even when alarmed, though at such times (especially when held between the fingers) they may make a squeaking or purring noise.

Adults, occurring from April to August, feed on the foliage and flowers of the host plant. The white, grublike larvae burrow within the roots of the living plant. Pupation occurs in the soil adjacent to the plant, one or two inches below the surface.

REFERENCE: Chemsak, J. 1963. Taxonomy and bionomics of the genus *Tetraopes* (Cerambycidae: Coleoptera). Univ. Calif., Pub. Entomol., vol. 30, pp. 1-90.

Leaf Beetles
Family Chrysomelidae

Like the preceding, these beetles are all plant feeders, primarily on flowers and foliage. Most are very small ("Flea Beetles") and a majority brightly colored, metallic blue being a dominant hue. The family is large, and many species occur in the Basin. Only the following attract attention:

Dichondra Flea Beetle
(*Chaetocnema repens*)

The larva of this species is a serious pest of dichondra lawns because of its abundance and habit of feeding on the roots of this plant. This stage is active during the warmer portion of the year and found to depths of 5 inches in the soil.

Adults are very small (1/16 inch long) and bronzy reddish black. They overwinter among the leaves of the host plant and may emerge to feed on warm days.

REFERENCE: McCrea, R. 1973. A new species of the flea beetle genus *Chaetocnema* found on dichondra in California. Pan-Pacific Entomol., vol. 49, pp. 61-66.

Western Spotted Cucumber Beetle
(*Diabrotica undecimpunctata undecimpunctata*)

Figure 196. Western Spotted Cucumber Beetle.

This is a small (¼ inch long) pale green beetle with several black spots on the wing covers. The legs, antennae, prothorax and abdomen are black.

The adults are found commonly on a wide variety of native plants and cultivated vegetation (except conifers). They eat mainly the epidermis of the leaves, which may be reduced to a translucent framework, but also feed on flowers and fruits.

The immature stages are spent in the soil. Females lay their eggs at the base of the host plant in the spring and midsummer. Larvae feed on the exterior of small roots and burrow within larger roots and tubers and pupate in an earthen chamber about 1 inch below the surface. The pupae have been observed to vibrate the tip of the abdomen violently when disturbed.

Blue Milkweed Beetle
(*Chrysochus auratus cobaltinus*)

At times, congregations of these medium-sized (⅜ inch long), beautifully metallic green, blue-green, or blue beetles are seen on the leaves of milkweed plants. The larvae are not known but probably feed on the roots.

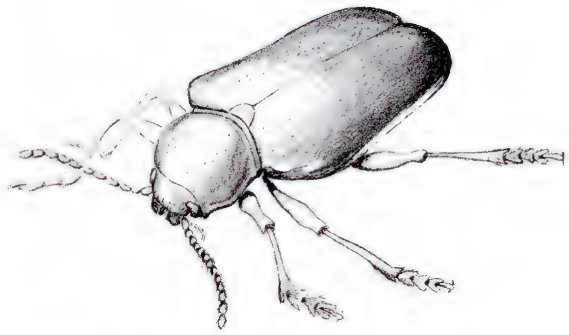


Figure 197. Blue Milkweed Beetle.

Weevils
Family Curculionidae

Weevils are a family of beetles in which the front part of the head is elongated into a snout or proboscis. The mouthparts are located at the tip of this proboscis and are generally modified for gnawing through tough-skinned buds, fruits, seeds or nuts.

The weevil family is the largest family of animals; there are somewhere near 35 thousand species throughout the world. Many forms live in the Basin; the following are those most frequently noticed:

Yucca Weevil
(*Scyphophorus yuccae*)

Figure 198. Yucca Weevil.

This weevil is large (5/8 inch long), and found from March to July, sometimes in considerable numbers, crawling among the swordlike leaves forming the basal rosette of the Common Yucca (*Yucca whipplei*) which grows on canyon slopes of our foothills. The adult beetles feed on the sap of the living plant. The larvae bore in the wood of the flower stalks and in the basal stems of non-flowering plants.

Fuller's Rose Weevil
(*Pantomorus godmani*)

Figure 199. Fuller's Rose Weevil.

Introduced from South America and known to attack many plants, this weevil is especially troublesome in citrus groves, where the adults trim new growth from young trees. The larvae live underground where they feed on roots, making furrows in the bark. Around the garden the beetles may be seen on roses, berry vines, and other ornamentals or vegetables, but may also develop on weeds.

The adult (about 1/3 inch in length) has a short snout for a weevil and is generally gray-brown in color. There is an oblique white area on each side of the wing covers. No males have ever been found and the females are known to be capable of producing fertile eggs without mating (parthenogenesis). The adults cannot fly; they are active from July to November when they are commonly seen crawling on host plants or resting on the walls of buildings.

REFERENCE: Dickson, R. 1950. The fuller rose beetle. A pest of citrus. Univ. Calif. Agr. Exp. Sta., Bull. 718.

Strawberry Root Weevil
(*Brachyrhinus cribricollis*)

Figure 200. Strawberry Root Weevil.

Like the preceding weevil, this is small (1/4 inch) and has a short snout, but is reddish black and has conspicuous punctures in the wing covers. The larvae are serious pests of strawberries, eating the fine roots and crown of the plant. The adults feed on the foliage of this and other plants (including privet) and may be fairly common in gardens. The females apparently are wholly parthenogenetic.

Vegetable Weevil
(*Listroderes costirostris obliquus*)

A small weevil (3/8 inch long), both larvae and adults eat the foliage of various garden or field crops. The larvae also feed extensively on the roots, especially of tuberous types. The brown adults may be recognized by the photograph and are characterized by a V-shaped marking across the wing covers.

The species is native to Brazil and was introduced into this country in the early 1900s.

Ants, Bees, and Wasps
Order HYMENOPTERA

The Hymenoptera are the third largest order of insects and undoubtedly the most beneficial from man's standpoint because of the great many valuable predators and parasites of insect pests and the important pollinators (the bees) of plants.

Members of this order are familiar to most of us, and little description is necessary to define the

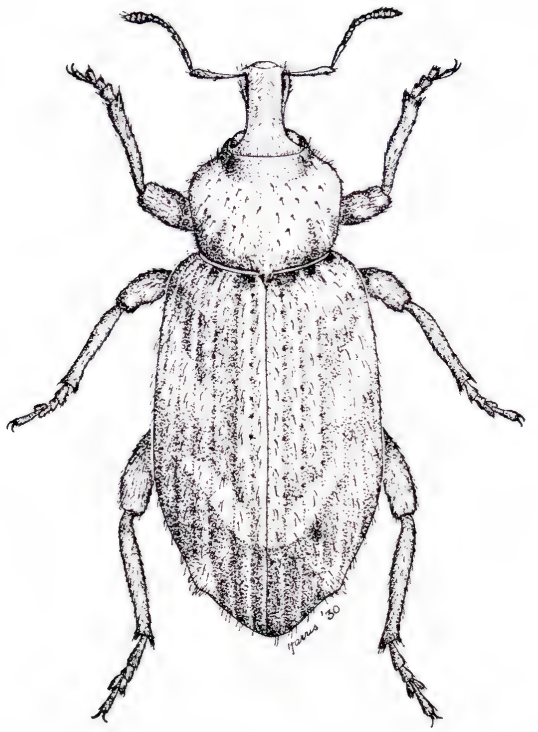


Figure 201. Vegetable Weevil. (From Essig, E. and W. Hoskins. 1944. Univ. Calif. Agr. Ext. Serv., Circ. 87, fig. 48)

three major groups: ants, bees, and wasps. As general rules of thumb, ants are always distinguishable by the knobs or nodes on the segments of the waist; bees always have finely branched hairs on the body (visible only with a strong lens); wasps are all Hymenoptera without these features. Most wasps are narrow waisted, but the wood wasps and sawflies have the abdomen broadly joined to the thorax.

The well-developed ovipositor of females of most Hymenoptera is often modified to form a stinger, a dominant characteristic and one of which many of us are painfully aware.

Ants
Family Formicidae

The ants are among the most fascinating of insects. Because of the interest of biologists and laymen alike, there exists a great deal of literature describing their classification and habits where one may read almost unbelievable accounts of their weird anatomy and habits. Consider the army ants (*Eciton*), which form legionary masses, killing and consuming other insects unable to escape them; the leafcutting or parasol ants (*Atta*), which plant and tend fungus gardens in their underground nests; and the giant hunting ants nearly an inch in length (*Paraponera clavata*), whose sting is considered the most excruciatingly painful of all venomous insects.

Ants are but a single family of the large order Hymenoptera. They are descended from and remain very similar to wasps, but are structurally and physiologically specialized to a highly developed social way of life. Within their social order there are typically three castes; male reproductives, female reproductives (queens), and female "non-productives" or "spinster sisters" (workers). Soldiers are found only in a certain few species.

Life within the average, established ant colony and the process of founding new colonies is similar in some ways to that of the termites. Periodically, when conditions are right within the colony and in the general environment, winged, fertile males and females disperse on nuptial or "wedding" flights. Mating takes place in the air during these flights, the supply of sperm received by the female remaining viable in her body for her lifetime. Soon thereafter the male dies, and the female (now properly called the queen) establishes a new colony. After breaking off her wings by rubbing them against the ground or rocks, she seals herself in a suitable nesting site, lays a batch of eggs and rears the young to maturity. This first generation assumes responsibility for feeding and maintaining the colony.

During their nuptial swarms ants are frequently mistaken for termites, (so-called "white ants"). Very different structurally from termites, however, ants may be readily distinguished from them in three ways: the ant's hind wings are much smaller than the fore wings; its antennae are elbowed; and its abdomen is separated from the thorax by a narrow waist from which usually a strong knob or node projects upward. The termite's four wings are equal in size and shape; the antennae are straight or gently curving; and they possess a broad, simple waist.

Because of their extremely well-organized societies, the ability to communicate with others of their kind and their often humanlike behavior, ants have been considered intelligent animals. Although capable of simple types of learning, they cannot reason and must, therefore, carry on all their activities according to an inherent, instinctive pattern. Communication is achieved by means of touch (antennae tapping), or the passing of odors

or glandular secretions from one ant to another; no complicated language or voice exists. An example of chemical communication is the "odor trail." An individual, having located a food source, will mark the path between this food and the nest with a chemical substance secreted from the abdomen. Other members of the colony then follow the path back to the food, aided by sensitive smelling organs located on the antennae and mouth.

REFERENCES: Creighton, W. 1950. The ants of North America. Mus. Comp. Zool., Harvard, Bull., vol. 104, pp. 1-585.

Mallis, A. 1941. A list of the ants of California with notes on their habits and distribution. So. Calif. Acad. Sci., Bull., vol. 40, pp. 61-100.

Wheeler, W. 1913. Ants, their structure, development and behavior. Columbia Univ. Press, N. Y.

Wilson, E. 1971. The insect societies. Belknap Press of Harvard Univ., Cambridge, Mass.

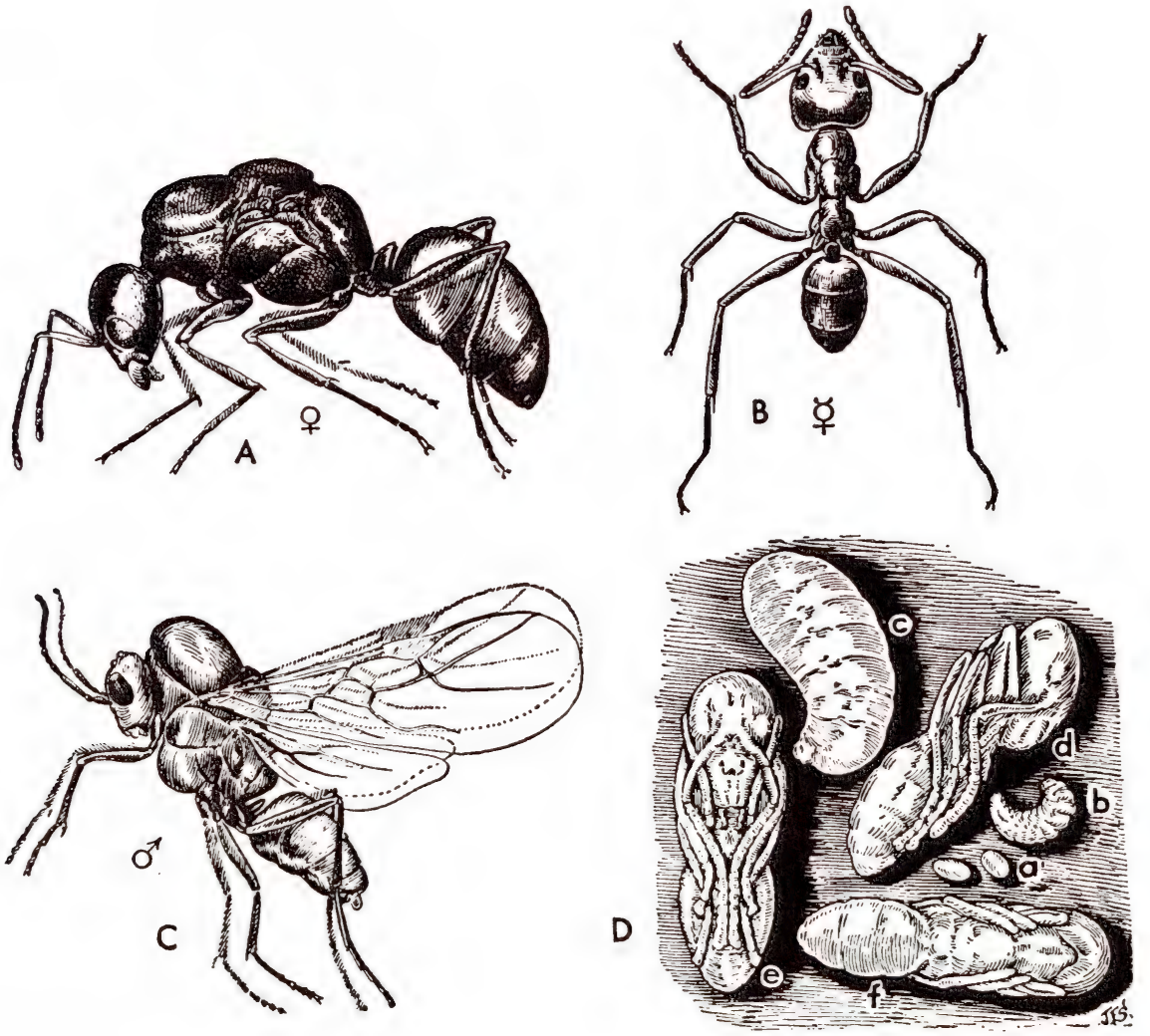


Figure 202. Argentine Ant: a.—queen, b.—worker, c.—winged male, d.—eggs, larva and pupae. (From Back, E. 1937. U.S. Dept. Agr. Leaflet 147, fig. 4)

KEEPING ANTS IN CAPTIVITY—ANT HOUSES

Most ground nesting ants may be cultured very nicely in an observation ant house. The latter may be purchased from toy stores, complete with ants, or homemade with very little effort. Basically, all that is required is a rectangular, narrow, wooden frame to either side of which has been laminated a piece of window glass or thin transparent plastic. Access holes are left at the top and a stand affixed to the bottom.

Establishing and maintaining an ant colony is very instructive. The California Harvester Ant is a good species to use because of its large size and availability—it is best to collect them during the winter when they are not active and less likely to sting—but other ground nesters serve nearly as well.

While many observations may be made on a group of confined workers, it is desirable to keep the queen as well. In order to obtain a queen, the entire nest must often be excavated and carfully searched. She may be recognized by her larger size and wing stubs; some colonies have more than one queen.

After a supply of ants has been obtained, they are introduced into the ant house, which has been previously filled with soil similar to that in which the ants are naturally found. Dry beach sand should be avoided; the ants cannot excavate it successfully because it keeps caving in. A small amount of water should be added to the soil from time to time to keep it slightly damp. The ants will soon dig a system of galleries and set up housekeeping. Their normal food should be kept available, of course: mealworms or insects caught at your porch light for carnivorous types; and wheat germ meal, or dog food for the vegetarians. A drop or two of honey as a treat once in awhile will be most welcome.

Quite a few species of ants live in the Basin. The following are the most familiar:

Argentine Ant
(*Iridomyrmex humilis*)

This is our most common ant, the little (3/32 inch long), blackish species which invades our homes and yards in search of food. Abundant in urban areas, it develops to prodigious numbers, and single colonies may harbor thousands of workers. It often becomes particularly noxious at the onset of cool weather in the fall, when colonies converge and move to sheltered, warmer quarters under homes, and foraging columns seek food indoors.

The Argentine Ant is an undesirable alien in this country. As its name suggests, it is native to South America (Argentina and Brazil). Apparently introduced into New Orleans before 1891 on coffee ships from Brazil, it has since spread rapidly over much of the United States.

One of the most persistent and troublesome of all our house-infesting ants, its workers seek out and feed on almost every type of food, being especially fond of sweets. Making themselves most objectionable, the ants invade everything in the house to which there is access through minute crevices and cracks—filing along baseboards, across sinks, and over walls and tables in endless trails. By protecting and tending them, workers also foster injurious scale insects and aphids in the garden.

Nests are made in the ground, often under rocks or wood, the galleries extending only 6-7 inches below the surface. There may be numerous queens in a single colony. The Argentine Ant is a highly competitive species, quick to exterminate other species of ants in newly invaded territory. The bite of this ant is feeble but it can be felt; it has no sting.

California Harvester Ant
(*Pogonomyrmex californicus*)

This is the big "red ant" with the bad sting which mothers warn their children to avoid. Apart from the large size (¼ inch) and red color, the

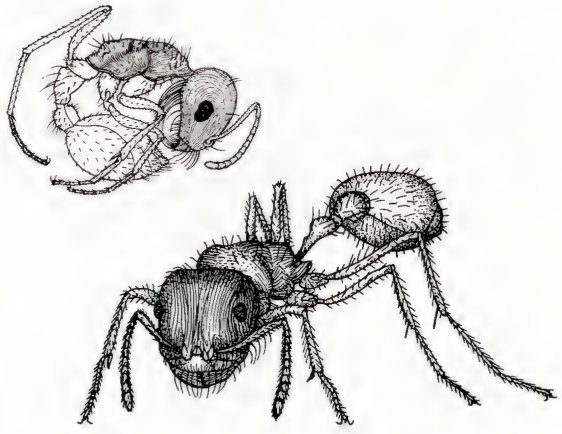


Figure 203. California Harvester Ant, worker (insert shows fright posture). (insert, From Woodworth, C. 1910. Univ. Calif. Agr. Exp. Sta., B. 207, fig. 28)

species may be recognized by its large head, which is finely grooved and "bearded" (with long hairs on the chin).

Nests are constructed in dry sandy soil and are evident as low, flat craters encircled by a small area devoid of plant growth. The workers harvest seeds for food and litter the periphery of the nest with the husks. Each evening they close the entrances to the nest, reopening it in the morning. The nest is kept permanently closed during the winter, when there is no outside activity.

REFERENCE: Michener, C. 1942. The history and behavior of a colony of harvester ants. Sci. Monthly, vol. 55, pp. 248-258.

Southern Fire Ant
(*Solenopsis xyloni*)

Figure 204. Southern Fire Ant.

A close relative of the infamous imported Fire Ant (*Solenopsis saevissima*) of the eastern United States, our species shows similar pestiferous habits and possesses a painful sting. Workers are especially fond of fatty or oily foods and may attack and kill young or newly hatched poultry, quail and other wild birds. They also build ugly mounds on lawns (evidence of their ground nests), gnaw vegetable and other crops, and make themselves obnoxious in many other ways.

The workers are distinguished by the characteristic way they raise and vibrate their abdomen when disturbed, and also by their color; a yellowish red head and thorax and a black abdomen.

Thief Ant
(*Solenopsis molesta*)

These are tiny (1/16 inch long) yellowish ants which commonly enter houses in search of food, preferring those rich in fat or protein. They nest in the soil and normally feed on dead insects and the like. Indoors, they often feed on grease,

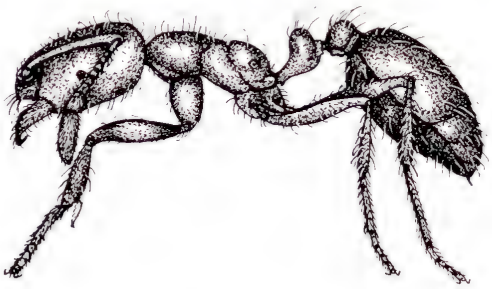


Figure 205. Thief Ant.

meat, and cheese. Because of their small size, they are not easily excluded from food containers.

The name "Thief Ant" alludes to its habit of establishing nests in or near those of other ants, which they then rob of food and brood.

Velvety Tree Ant
(*Liometopum occidentale*)

Figure 206. Velvety Tree Ant.

Typical nesting areas of this species are cavities and beneath the bark of trees growing along stream banks. Workers range up and down the trunks and branches, tending aphids from which they extract honeydew.

About ¼ to ½ inch in length, this ant is easily recognized by its red thorax, glistening velvety black abdomen and brownish black head, not to mention its strongly pungent odor when crushed or disturbed.

Carpenter Ants
(*Camponotus* species)

Figure 207. A carpenter ant *(Camponotus vicinus)* queen.

Carpenter ants are so called because many species build their nests in wood. Usually they inhabit preexisting cavities, such as abandoned termite galleries and rot holes, or burrow in rotten wood. But certain species (fortunately none of our local ones) excavate sound wood and are destructive to house timbers, telephone poles and the like. They do not eat the wood, but merely tunnel through it. Their natural food consists of both dead and live insects, honeydew and other sugar substances (rotting fruit, plant sap, etc.).

These are large ants (usually up to ⅝ inch long). Our local species usually exhibit a reddish or yellowish thorax and black abdomen. Nests are most often situated in the soil and, in this locality, are found indoors only accidentally. In the Basin there are three species of *Camponotus*: *vicinus, semitestaceus,* and *clarithorax. Camponotus laevigatus* is an all black and extremely common wood-nesting carpenter ant found in fallen coniferous logs at higher elevations in the neighboring San Gabriel mountains.

Wasps

All members of the order Hymenoptera, excepting bees and ants, are commonly and technically considered to be wasps. Of infinite variety, they range from the large stingless horntails to the minute parasitic chalcids. Most familiarly associated with the name, however, are the stinging, social and semi-social nest building forms including, among others, paper wasps, yellow jackets and hornets.

A word about the stings of wasps is appropriate here. Although it is true that the females of most species are capable of stinging, with few exceptions they must be roughly handled to get them to do so. The effects of the sting are usually not serious, causing only temporary pain and swelling. Of course, multiple stings or a single sting on a sensitive person, may cause general trauma or even death. Unlike the honey bee, the barbs on the wasp's stinger are very fine and do not catch in the flesh. It may be repeatedly inserted and withdrawn from the wound.

REFERENCE: Evans, H. 1963. Wasp Farm. Natural History Press, N.Y.

Vespid Wasps
Family Vespidae

Yellow Jacket
(*Vespula pensylvanica*)

Figure 208. Yellow Jacket.

With an abdomen broad to the base and marked on the back with black bars and spots, this very common wasp is unlike the narrow waisted Golden Polistes and the Mud Dauber.

Nests consist of multiple layers of cells enclosed in a globular outer shell. As in the case of the following species, the nest material is a papery substance formed by mixing saliva with fibers rasped from dead wood until a pulp is formed (not unlike papier-mâché). Ranging in size from 2 - 12 inches in diameter, the nests are usually situated in underground chambers.

Colonies consist of many individuals (as many as 15,000) which are differentiated into males, queen, and female workers; the latter are some-

what smaller than the queens and sexually impotent.

This wasp is attracted to fruit and meat and at times may be very abundant; because of its inquisitiveness and painful sting, it can become a great nuisance to picnickers and campers.

REFERENCES: Bohart, R. and R. Bechtel. 1957. The social wasps of California. Calif. Insect Survey, Bull., vol. 4, pp. 73-102.

Duncan, C. 1939. A contribution to the biology of North American vespine wasps. Stanford Univ. Pub. Biol. Sci., vol. 8, pp. 1-272.

Golden Polistes

(*Polistes fuscatus aurifer*)

Figure 209. Golden Polistes.

Distinguished from the Yellow Jacket by the narrowed waist and nearly solid yellow abdomen, this is our most common local wasp.

The umbrella-shaped nests, made of a paper-like substance composed of a single layer of cells, are attached by a short stem to the underside of overhanging surfaces (eaves, fence rails, etc.). A new nest is constructed each spring by an overwintering female which mated the previous autumn.

Adult wasps gather caterpillars, which they skin and chew before feeding them to the grublike larvae developing in the cells.

Colonies consist of males, females and workers, all of the same general form. Workers are fairly easily provoked and sting forcibly.

Sphecid Wasps
Family Sphecidae

Mud Dauber

(*Sceliphron caementarium*)

In common with the Golden Polistes, this species has a narrow waist (a much longer one, however), and the abdomen is usually predominently black instead of yellow. Adults also twitch their wings characteristically while walking or standing.

The mud nests, built by the females, are stuck to walls and rafters of attics and garages, under eves, beneath rocks, or wherever there is protection from the elements. They consist of 2 to 6 or more elongate cells placed in series side by side. Females provision these cells with paralyzed spiders upon which the larvae feed.

Nest building and egg laying take place in the late summer and fall and, soon after, the females die. Larval development proceeds rapidly, and the mature larva passes the winter nestled in its brown cocoon within the mud cell. Pupation occurs in the spring, and the adults emerge soon thereafter.

Mud Daubers are non-aggressive and seldom sting. Even when they do so, the effects are generally mild.

REFERENCE: Shafer, G. 1949. The Ways of a mud-dauber. Stanford Univ. Press, Stanford.

Sand Wasps

(*Bembix* species and related genera)

Also known as Digger Wasps, these wasps are recognized by their stout shape and greenish white or bluish white abdominal markings. A close look at the head reveals that they have unusually long mouthparts (including a triangular labrum).

Characteristic inhabitants of dry, sandy areas such as beach bluffs and mesas, sand dunes and arroyos, these wasps fly low and rapidly over the ground seeking prey and tending their burrow nests. The latter are shallow tubes running obliquely into the soil, containing a single larva which the female keeps supplied with a diet of

Figure 210. Mud Dauber, adult on nest (above), rear view of nest removed from substratum, showing early stages.

Figure 211. Sand wasp.

fresh flies and other insects. In practicing this form of continuous provisioning of the larvae, Sand Wasps differ from Spider Wasps, Mud Daubers and many other digging wasps which provide their larvae with only a single cache of food that must last throughout their development. Sand Wasps are not social wasps as are hornets and yellow jackets; yet, as a result of the tendency of individuals to nest in the same area, a type of colony develops.

Several genera and species of these interesting insects live in the Basin. The most common is the Western Sand Wasp (*Bembix occidentalis*), found on and near the beaches.

REFERENCE: Evans, H. 1957. Studies on the Comparative Ethology of Digger Wasps of the Genus Bembix. Comstock Publ. Co., N.Y.

Spider Wasps
Family Pompilidae

Tarantula Hawk
(*Pepsis*)

The Tarantula Hawk is a giant wasp, indeed one of the world's largest; some female individuals have a body length of nearly 2 inches. In addition to its great size, this insect is easily recognized by its dark, steely-blue body and contrasting orange-red wings. Differences in the antennae distinguish the sexes: in the females they are coiled outwardly into a circle; in the males they are straight or gently curving. But be careful! An occasional female may straighten her antennae.

This wasp is no longer common in our area, but an occasional one may be seen in the hilly parts

Figure 212. A tarantula hawk *(Pepsis)* stinging prey.

of the Basin, bumbling over milkweed (spring and summer) or scale broom (*Lepidospartum*) in the fall, or buzzing low over the ground in search of the tarantulas (*Aphonopelma*) on which it preys.

When a female wasp finds a tarantula, she alights and engages it in battle. The wasp then attempts to sting the spider on the underside between the legs, usually succeeding in paralyzing the spider but not killing it. Previously the female has dug a shallow burrow, using her mandibles and legs as pick and shovel, or selected an earth crack, rodent burrow (or even the burrow of a tarantula). She drags the paralyzed prey into the hole, lays an egg on it, and then seals the tunnel with soil. A supply of fresh food is thus insured for the developing larva.

The sting of the female Tarantula Hawk is described as extraordinarily painful by those who have experienced it.

REFERENCE: Williams, F. 1956. Life history studies of *Pepsis* and *Hemipepsis* wasps in California (Hymenoptera, Pompilidae). Entomol. Soc. Amer., Ann., vol. 49, pp. 447-466.

Velvet-Ants
Family Mutillidae

Velvet-ants
(*Dasymutilla*)

Velvet-ants are not really ants at all, but wingless female wasps; the males (and occasionally females) are winged like other wasps. With conspicuously brightly colored vestiture of long, fine hairs, they always attract attention in the arid, sandy areas they prefer. Though most frequent in our deserts and foothills, they live also on the coastal dunes and bluffs.

Figure 213. A velvet-ant (*Dasymutilla*).

Very little is known regarding the life cycles of these wasps. Available information suggests that they are parasitic on other ground-nesting wasps and bees.

The female stings unhesitatingly, causing a sharp pain which quickly subsides, producing little or no swelling or other side effects. Females are capable of emitting a faint squeeking sound when confined.

Several species of velvet-ants occur in the Basin. All exhibit contrasting black and yellow, red, orange, or white color patterns. Unfortunately for the layman, the principle colors are not consistent according to the species (a species may exhibit two or more color phases in different geographic areas), and so it is impossible to distinguish them superficially.

REFERENCE: Hurd, P. 1951. The California Velvet-ants of the genus *Dasymutilla* Ashmead. Calif. Insect Survey, Bull., vol. 1, pp. 89-118.

Cuckoo Wasps
Family Chrysididae

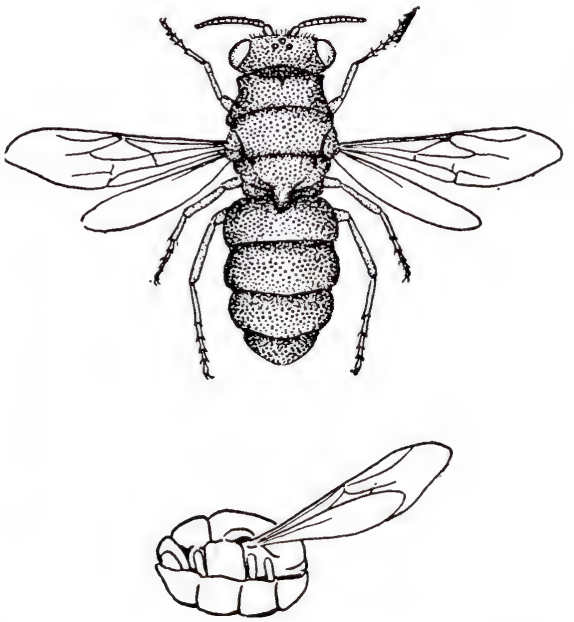


Figure 214. Cuckoo wasp. (From Essig, E. 1929. Insects of Western North America, fig. 732)

These are small beelike wasps, usually deep metallic blue or green in color and sparsely haired. They can roll themselves into a ball by burying the head in the concave abdomen.

Cuckoo Wasps are parasitic on bees and other wasps, the larvae developing on provisions left in the cells of the latter.

Gall Wasps
Family Cynipidae

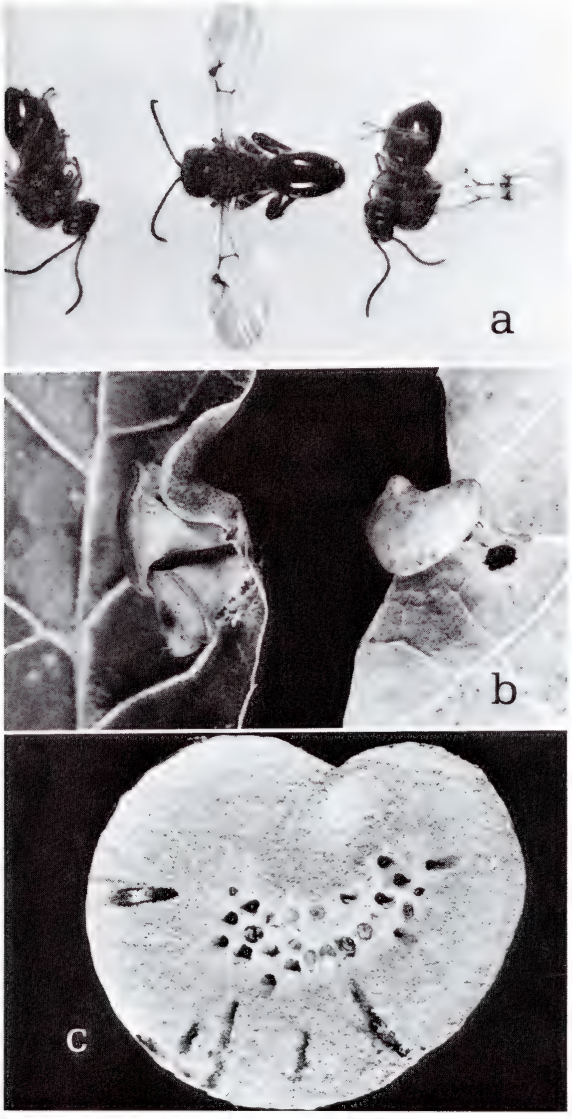


Figure 215. California Gallfly: a.—adult wasps, b.—leaf galls (sexual phase), c.—apple galls (asexual phase).

We frequently notice galls because of their curious shapes, and because they often mar the beauty of ornamental plants. They appear as grotesque, abnormal growths on leaves, stems, flowers, roots and other parts of the plant, and assume a multitude of forms including fleshy mushrooms, gnarled, hard knots, star-shaped or spiny projections, and large, smooth, reddish spheres. The last are especially common on oak trees and, because of their similarity to that fruit, are called "oak apples."

Oaks seem to be a favored host for gall wasps in general. Many species infest our white, black and scrub oaks, and the gall made by each is typical of the species. Two of the most common are the following:

1. Live Oak Gallfly. (*Callirhytis pomiformis.*) On the Coast Live Oak (*Quercus agrifolia*). Apple galls caused by asexual generation; mushroom leaf galls caused by sexual generation.

2. California Gallfly. (*Andricus californicus.*) On White Oaks (*Quercus lobata, dumosa* etc.). Adults emerge from the apple galls in October.

The adult gall wasp is a small insect (usually less than ¼ inch in length), and dark or somber-colored. The thorax has a somewhat humped appearance, causing the head to be oriented downwards, and the abdomen is frequently compressed from side to side.

The mechanism by which the female wasp or feeding larvae cause the galls to be formed is not well understood. Some chemical stimulus causes the plant to grow excess tissue in a specific shape. This tissue is utilized by the wasp larva as food. Upon maturing, the adults burrow out of the gall, leaving a small hole on the surface.

Some gall wasps exhibit an alternation of generation in their life cycle, i.e., during one phase of development males as well as females are produced and reproduction is sexual, whereas in the other phase only females are present and reproduction is asexual. The insects of the two generations may be structurally different, appearing to be distinct species.

REFERENCES: Brown, L. and C. Eads. 1965. Oak gall insects. Chap. V *in* L. Brown and C. Eads. A technical study of insects affecting the oak tree in southern California. Univ. Calif. Agr. Exp. Sta., Bull. 810.

Weld, L. 1957. Cynipid galls of the Pacific Slope (Hymenoptera, Cynipoidea). Publ. by author, Ann Arbor.

Ichneumons
Family Ichneumonidae

Figure 216. A common ichneumon wasp *(Ophion)*, female.

These solitary wasps are, for the most part, small and have more slender bodies and legs than do the familiar social and semi-social types. Often the abdomen is strongly flattened from side to side. All are parasitic on other insects; our most common local species belong to the genus *Ophion* and attack caterpillars. The eggs are inserted into the body of the host by means of the female's short, sharp ovipositor which, incidentally, can penetrate human skin. The larvae feed on the internal tissues and, when mature, pupate within the host. The adults frequently come to lights at night.

Horntails or Wood Wasps
Family Siricidae

Figure 217. A woodwasp *(Sirex longicauda)*, male.

These wasps are so named because of a horn-like projection borne at the tip of the abdomen. Below this projection, the females also carry a very long, rigid ovipositor used to insert the eggs deep into dead or dying coniferous wood, which is the food of the larvae. The latter burrow through the wood, forming tunnels which considerably reduces its value as lumber.

These insects are widely disseminated in shipments of infested lumber or timber, and the adults may not emerge until several years have elapsed. In the Basin, I have encountered several instances of adults exiting from wall studs, through the plaster facing and into the interior of homes. When a load of infested lumber has been used in a housing development, such emergence may be extensive and cause alarm among the new residents.

REFERENCE: Middlekauff, W. 1960. The siricid wood wasps of California. Calif. Insect Surv., Bull., vol. 6, pp. 59-78.

Megachilid Bees
Family Megachilidae

Leaf Cutter Bees
(*Megachile* species)

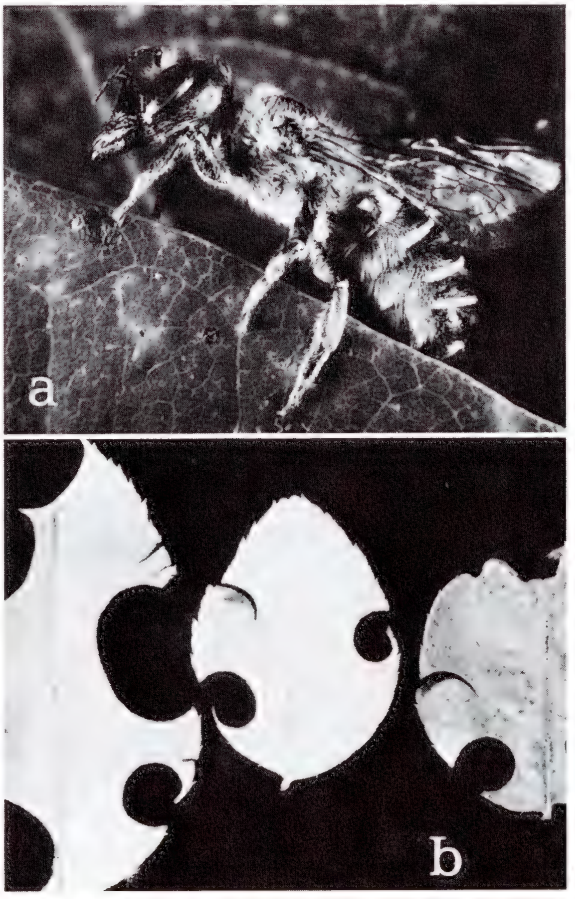


Figure 218. Leafcutter bee: a.—adult bee, b.—leaves showing typical excisions made by bees.

Neatly cut, semicircular notches in the leaf edges of one's rose bushes indicate the presence of these solitary bees in the neighborhood. The females of this family of solitary bees cut the leaf fragments with their mandibles and carry them to a natural tubular cavity or burrow, where they form a lining for the nest. Provisions for the larvae consist of pollen and honey.

The few species of Leaf Cutter Bees in the Basin are medium-sized (¼ - ½ inch long), usually black or dull metallic blue in color and with abundant hair on the head, thorax and legs.

Halictid Bees
Family Halictidae

Metallic Sweat Bees
(*Agapostemon, Augachlorella*)

Figure 219. Metallic sweat bee.

Solitary bees of medium size (⅜ inch long) with brilliant metallic green bodies; the males of *Agapostemon* have the abdomen light brown with black rings. They nest in tubular burrows dug in the ground, often in clay banks.

Anthophorid Bees
Family Anthophoridae

Carpenter Bees
(*Xylocopa*)

These very large bees are commonly mistaken for bumblebees, to which they are not related and from which they differ in being solid black or steely blue (females) or light brown (males of certain species). Bumble bees, on the other hand, are typically marked with yellow and black.

Carpenter bees are so named because they bore into wood, forming tunnellike nests for the rearing of the young. Many kinds of wood are used. Although fence posts, building timbers, telephone poles etc. often are attacked, the effects are seldom damaging.

Upon completion of its nest tunnel, the female places pollen and nectar at the far end, lays an egg and closes off a cell with a partition of wood pulp. Five or six such cells are formed and sealed in succession. In about a week the eggs hatch and the larvae feed on the pollen and nectar, maturing in about 6 weeks. Adult bees emerge after about 40-45 days and egress from the entrance of the tunnel. Since all mature at about the same time, the bee at the deep end must wait for those nearest the single exit to escape first.

Commonly found about flowers in the less developed parts of the Basin, the formidable size and habit of "buzzing" people earns these bees a bad reputation. The females can sting but do so very reluctantly, causing only mild pain.

Three kinds live in the Basin:

1. Valley Carpenter Bee (*X. brasilianorum varipuncta*).

This is the lowland and most common species. The male is light brown, the female metallic black with bronzy reflections on the body and wings. It bores in lumber and logs (often eucaylptus).

2. California Carpenter Bee (*X. californica diamesa*).

Both male and female are dark blue; in certain light the body reflects a greenish cast. Burrows are usually constructed in the dry, dead stems of the Common Yucca (*Yucca whipplei*). It is most common at higher elevations.

3. Mountain Carpenter Bee (*X. tabaniformis orpifex*).

Both male and female are largely black; the male has some white hair on the thorax. Native softwoods are used primarily for the nests. It is most common, also, at higher elevations and is the smallest of the three forms.

REFERENCE: Hurd, P. 1955. The carpenter bees of California. Calif. Insect Surv., Bull., vol. 4, pp. 35-72.

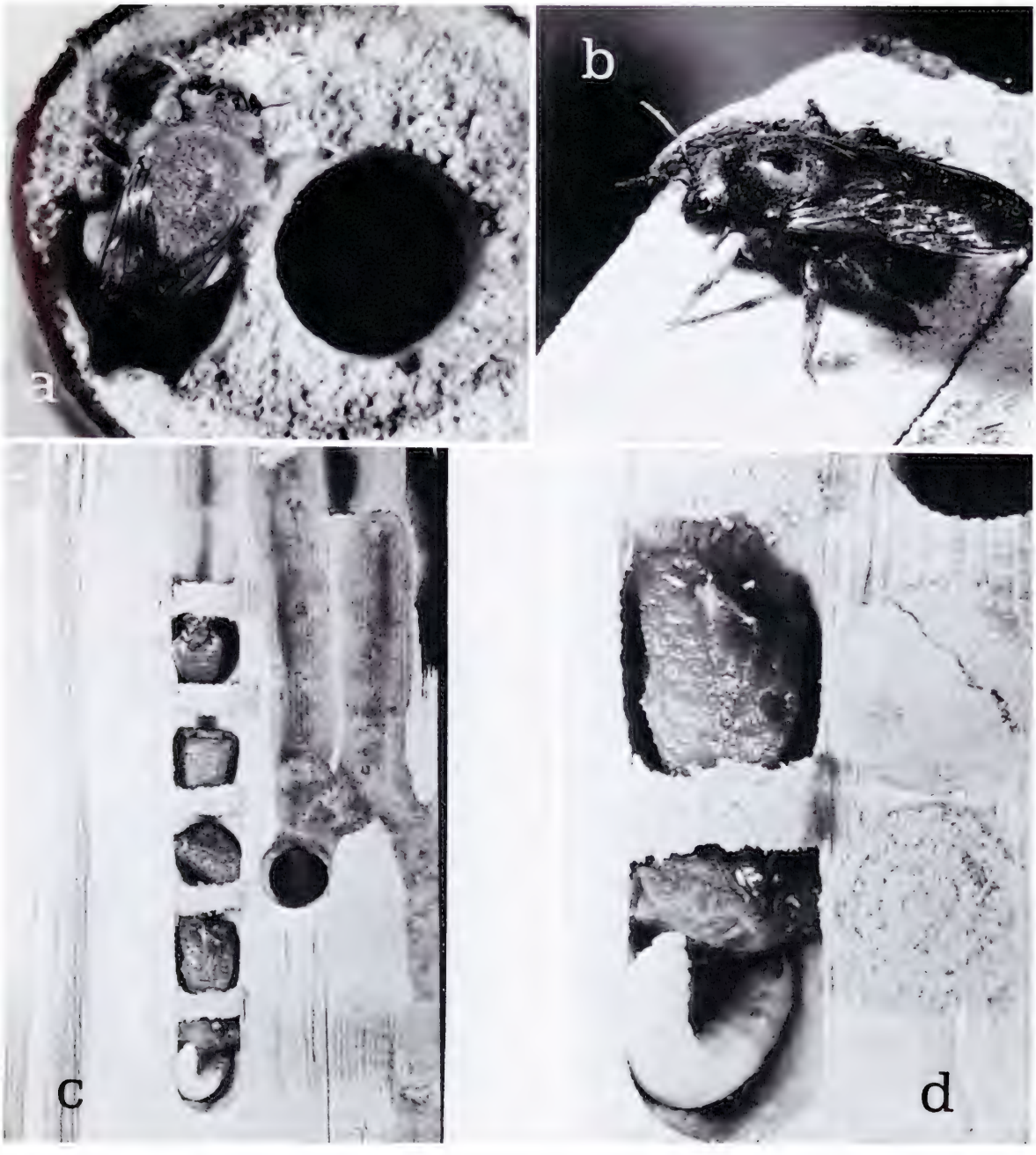


Figure 220. Valley Carpenter Bee: a.—male, emerging from nest hole; b.—female; c.—nest in section; d.—close-up of terminal cells, note larva.

True Bees
Family Apidae

Bumble Bees
(*Bombus*)

Familiar to most everyone, bumble bees may be easily recognized by their large size and densely furred bodies of black and yellow hairs. They are sometimes confused with the carpenter bees which are also large, but which are easily distinguished by their solid black color, as previously mentioned. Equally as characteristic as size and coloration is their loud buzzing flight. It is to this that the name "bumble" refers; the word comes from the Middle English *bumblen* which means "to hum." The

modern German word for bumble bee is *Hummel*; in Britain they are "humble bees."

Bumble bees are annually social. That is, the colony dies out each winter. New colonies are formed in the spring by fertile queens which have hibernated in protected places such as crevices in trees or under bark. The nests, constructed in cavities in the ground, consist of a cluster of irregular, rounded wax cells sheltered by a matting of dry grass or twigs. The young are reared in these cells on a diet of pollen and honey. The first brood is tended by the queen, but her offspring care for the subsequent generations.

Figure 221. Bumble Bee.

The females and workers sting severely, but our species, at least, are not easily provoked.

Four species occur sporadically throughout the Basin:

1. Sonoran Bumble Bee (*Bombus sonorus*). Largely yellow, apex of abdomen black; a thin black band across thorax; face entirely black.

The most common species, no longer abundant, nests at the base of shrubs and rushes in marshy flats near the coast.

2. California Bumble Bee (*Bombus californicus*). Yellow on abdominal segment 2 only, apex of abdomen black; face black.

3. Vosnesenski's Bumble Bee (*Bombus vosnesenskii*).

Body hair like *californicus*; face yellow.

4. Crotch's Bumble Bee (*Bombus crotchii*). Yellow on abdominal segments 2 and 3 only, apex of abdomen reddish; face black.

REFERENCES: Free, J. and C. Butler. 1959. Bumblebees. Collins, London.

Ryckman, R. 1953. Notes on the ecology of *Bombus sonorus* in Orange County, California and new parasite records. Pan-Pacific Entomol., vol. 29, pp. 144-146.

Honey Bee
(*Apis mellifera*)

Figure 222. Honey Bee, worker.

The Honey Bee is not a truly domesticated insect, although it is often referred to as such. The practice of apiculture, man's keeping of bees for their products, is nearly as old as agriculture itself. Today we provide the bees with specially constructed hives, which replace the hollow trees and caves that were the original homes of the honey bee. Even today, many bees escape their man-made homes and return to the wild, where they often survive quite well. Unfortunately for the homeowner, they often choose an attic for their new home.

The Honey Bee originated in southern Asia and was not introduced into America until the middle of the 17th Century. It is not known how the bees were first successfully transported on the long journey from the Old World to the New, but there is no doubt that colonies made the trip safely more than once.

There are at least five different races of the Honey Bee, and a multitude of strains within each of these. Each has its own structural and behavioral characteristics, some desirable from the apicultural standpoint, others undesirable. Much hybridization occurs between these types, and artificial insemination techniques are used in modern breeding techniques.

The Honey Bee is an exemplary social insect, living in a colony which consists of the offspring of a single original reproductive pair, all of which exhibit a high degree of cooperation in their activities. Thus the colony is a large, complex family. Members of this family are of three types, each with a specific body form and set of duties in the colony:

Queen (Reproductive female)—Lays eggs (1,200-2,000 or more a day); acts as control center of the colony. Takes no part in caring for the young.

Workers (Non-reproductive females)—Carry on most of the hive and field activities; gather nectar, pollen and water; build the honeycomb; feed the queen; form the honey; clean and ventilate the hive, etc.

Drone (Male)—Only functions to fertilize virgin queen at swarming time, usually dying soon afterwards.

The swarming of Honey Bees is a spectacular phenomenon, existing for the purpose of colony reproduction. There are two types of swarms: Dispersal swarms—an impregnated queen leaves the hive with a group of workers and a new home is sought. Mating swarms—One or more virgin queens leave the hive with a few drones, with which they mate, and many workers. A new home may be sought or the swarm may return to the old one just vacated.

Swarms are a frequent source of concern to local residents. The bees may temporarily settle near places of habitation, perhaps establishing hives in chimneys or in the walls of houses. Such situations are best handled by experienced apiarists (beekeepers).

Swarming bees are usually rather docile, as are bees most of the time, and will not sting unless provoked. Stings are most commonly of little consequence, but hypersensitive persons may suffer extreme reactions or even death. In any case, the stinger should be removed as soon as possible to prevent the entrance of an unnecessary amount of venom, which continues to flow into the wound under pressure from the attacked, pulsating poison sac. Scrape out the sting with a knife or fingernail or lift it with forceps, avoiding pressure on the venom sac.

The sting of the worker is coarsely barbed and usually remains in the wound, pulling out of the bee with vital organs attached, thus killing it. The queen can also sting, but the drones cannot.

Honey is the best-known and most valuable product of the Honey Bee. To the bee it is an important food, for man it is centuries-old food and elixir. Honey, manufactured by the bees from flower nectar, consists mainly of glucose and fructose sugars. Nectar is the bee's carbohydrate food source; they also store and eat pollen, which supplies protein.

Much has been said about the cosmetic use of another bee product, royal jelly. As yet, however, no definite evidence exists to support claims that it benefits the human skin when applied topically. The bees use it as special food for the queen (larva and adult), and young worker larvae.

Beeswax, the construction material of the comb, is secreted by special glands in the abdomen of the bee. It has many legitimate industrial and home applications.

Very much more could be said about this fascinating insect. However, space does not allow a fuller discussion and the reader is referred to the references to satisfy his curiosity.

REFERENCES: Butler, C. 1955. The World of the Honeybee. Macmillan, New York.

Ribbands, C. 1953. The Behaviour and Social Life of Honeybees. Bee Research Asso. Ltd., London. (Available in Dover reprint)

Root, A. and E. Root. 1929. The ABC and XYZ of Bee Culture. A. I. Root Co., Medina, Ohio.

COMMON TERRESTRIAL ARTHROPODS

Arachnids

Class Arachnida

Scorpions

Order SCORPIONIDA

Scorpion anatomy is common knowledge to most people: Large "lobster" claws, eight legs, and an elongate body with a slender segmented tail tipped by a bulbous sting, immediately set them apart from their relatives. A pair of conspicuous comblike structures on the belly, held in a spreading position like birds' wings, further characterize these animals. The function of these organs is not definitely known, but they may serve to perceive ground vibrations.

This is an invertebrate which has prompted odd beliefs from earliest times, and it is the only arachnid having a place among the signs of the Zodiac, Scorpio. The popular belief that, when exposed to fire, scorpions sting themselves to death, thus committing suicide, is without validiy.

In the Basin scorpions are most likely to be encountered in foothill areas being developed for residences. When their natural hiding places are disturbed or destroyed, they often seek shelter around or within homes, finding their way into the garage, kitchen or back porch on their nightly wanderings.

All scorpions are nocturnal, moving about in search of soft-bodied insects for food. They feed most often on beetles, cockroaches, centipedes, spiders, sun spiders and other ground dwellers.

In nature, they live in burrows, under rocks and logs lying on the ground, in sand and under loose tree bark. Around human habitation, they thrive in lumber piles, accumulations of boxes, rags, brush, rubble etc., and in crevices and seldom-used areas such as cellars, garages, attics and the like. Scorpion eradication around the home consists mainly of keeping the premises clean and free of litter.

Courtship in scorpions takes the form of an exotic dance. Typically, on finding a female, the male grasps her claws with his and promenades sideways or backward with her. Copulation occurs after an extended period of such activity. In the course of reproduction, the fertilized eggs develop within the female, and the young are born alive, often in batches. Until the first molt the young are carried upon the mother's back and subsist on embryonic yolk; they are not fed by the mother.

None of our local scorpions is considered dangerous, although they may inflict painful wounds. Southern Arizona and portions of neighboring states can actually claim two lethal species. In Arizona, during a twenty-year period, these have been responsible for 68% of the deaths due to venomous creatures, more than twice as many as all other types put together, including rattlesnakes.

The stings of our scorpions usually cause only a local reaction similar to that of a bee sting, consisting of pain and a burning sensation, with swelling which lasts from a few minutes to over an hour. First-aid treatment consists of immersing the affected area in ice water or applying an ice pack. If symptoms persist a physician should be consulted.

REFERENCES: Parrish, C. 1966. The biology of scorpions. Pacific Discovery, vol. 19, pp. 2-11.
Ennik, F. 1972. A short review of scorpion biology, management of stings, and control. Calif. Vector Views, vol. 19, pp. 69-80.

The following two are the most likely species to be encountered in the Basin although at least two additional definite residents (Confusing Scorpion, *Vejovis confusus,* and Gertsch's Vejovis, *V. gertschi*) and an occasional intruder (the dangerous *Centruroides sculpturatus*) are known:

Shiny-stinged Scorpion
(*Anuroctonus phaeodactylus*)

This is the most common species, distinguished from the next two by its larger size (length from the front of the body to the tip of the extended tail, 2 inches), solid dark-brown color, and bulky claws. The sting is naked and shiny; between the tip of the sting and the base there is frequently a second, small inflated bulb. Nesting burrows are dug (often in colonial aggregations) by the male to a depth of 6-8 inches, by the female to a depth

of up to 2 feet. This species ambushes prey from the mouth of the burrow during the night, retreating into its shelter during the day or when startled or threatened. It seldom uses its sting.

Figure 223. Shiny-stinged Scorpion.

Silvestri's Scorpion
(*Paruroctonus silvestrii*)

Figure 224. Silvestri's Scorpion.

This and the following are quite similar, differing from the foregoing by their smaller size (body length, including tail, 1 inch), light color and more slender claws. Both are also more active, pursuing prey, running to escape enemies and hiding under debris. They often sting their prey.

The body of Silvestri's Scorpion is mottled dark gray-brown (except the last segment), and the underside of the tail is conspicuously marked with four longitudinal dark brown lines. It lives in the foothills and mountains surrounding the Basin, including the Palos Verdes Hills.

Figure 225. Confusing Scorpion.

Sun Spiders
Order SOLPUGIDA

These hairy arthropods are greatly feared because of their ferocious appearance. Although they possess a formidible pair of jaws (chelicerae), capable of pinching with some force, they are actually harmless, since there are no poison glands or stings anywhere in the body.

The group is also known by several additional names; Wind Scorpions, Scorpion Spiders, False Spiders, and Hunting Spiders. Although somewhat similar in appearance to spiders or scorpions, they belong to a distinct order. They also bear a resemblance to Jerusalem Crickets, for which they are sometimes mistaken locally.

At the tip of each of the front pair of slender appendages (pedipalps) is a sucker which enables the animal to climb smooth surfaces, and which also assists in feeding, drinking and battling. The remaining appendages are true legs. Each of the hind two pair has a row of wedge-shaped structures called racket organs. Their function is unknown but believed to be related to the perception of ground vibrations.

Sun Spiders predominately inhabit hot, dry desert areas. In the Basin they are not common, although they occasionally occur under stones or in sandy soil and may be attracted indoors by lights on warm nights. They are ground dwellers and excellent excavators. When digging, they push the soil ahead of them like a bulldozer, the pedipalps holding the pile from the sides, the chelicerae pushing from the rear. All of our species are nocturnal, wandering by night in search of the small invertebrate animals serving as prey. Extremely voracious carnivores, they crush and tear the captive organism to shreds with their huge jaws.

Figure 226. A sun spider.

Our seven local species, all in the family Eremobatidae (none of which has a common name), are *Hemerotrecha marginata; Therobates morrisi; Eremobates scopulatus; E. purpusi; E. zinni; E. mormonus; E. gracilidens.*

REFERENCE: Muma, M. 1970. A synoptic review of North American, Central American, and West Indian Solpugida (Arthropoda: Arachnida). Arthropods of Florida and neighboring land areas, vol. 5.

Daddy Long-legs
Order PHALANGIDA

Though they resemble spiders, Daddy Long-legs (or Harvestmen as they are sometimes called) belong to a separate order of arachnids. The extremely long, slender legs and abdomen fused to the head-thorax are characteristic. Also, there are usually only two eyes, located on a tubercle atop the head region, one looking out to each side.

With crushing mouthparts, these creatures feed primarily on fresh or recently dead insects, pillbugs, spiders, etc. They may scavenge almost any kind of organic matter.

Daddy Long-legs live in low growing vegetation and frequently inhabit ground cavities under stones, boards, brush and similar secluded places.

Figure 227. A daddy long-legs *(Protolophus singularis).*

There are several local species of phalangids. Perhaps the commonest are the following: *Protolophus singularis,* grayish with short legs and toothed tubercles on the back and *Leuronychus pacificus,* a very long-legged, light brown species with a broad, brown band running down the middle of the smooth back.

REFERENCE: Banks, N. 1911. The Phalangida of California. Pomona Coll. J. Entomol., vol. 3, pp. 412-421.

Spiders
Order ARANEIDA

Spiders are such familiar arthropods that they really require no description, although several peculiarities should be pointed out: they all have 8 legs plus a pair of anterior, leglike appendages called *pedipalps* which serve as sensory structures and, in the male, carry the copulatory organs. The genital opening is at the rear of the abdomen in its normal position, but the sperm are transferred to the pedipalps which in turn, transfer them to the female during the mating process.

Spiders also feed in a special way. All are predaceous and subdue their victims with poison injected by a pair of fangs situated just in front of the mouth. By utilizing digestive enzymes regurgitated from the mouth, food is not swallowed whole but first liquified externally and then slowly imbibed.

Unlike insects, spiders do not have a distinct head. Instead, it is fused imperceptibly with the thorax, forming a combined body section called the cephalothorax. The only evidence of the head on this body region is the mouth, the associated fangs just mentioned, and the eyes. There are several eyes, usually eight, lying atop the cephalothorax.

Spiders are as well known by their webs as by their body form. Each kind of spider spins its own distinctive type of web, and sometimes has several types of webs for different purposes. Usually they function as a snare for prey, but they can also serve as a home for the spider, a place to rest and find protection from the elements, or a place to raise young. Often a tight silken bag or ball is spun around the egg mass, which the mother carries about until the eggs hatch. The silk is produced by special glands within the abdomen opening to the outside through a set (usually three pairs) of fingerlike appendages at the rear end, called spinnerets.

REFERENCES: Comstock, J. (Second edition. Revised by W. Gertsch). 1940. The Spider Book. Doubleday, N.Y.
Gertsch, W. 1949. American Spiders. Van Nostrand, N.Y.
Kaston, B. and E. Kaston. 1972 (Second edition). How to Know the Spiders. W. C. Brown, Co., Dubuque.

Many species of spiders live in the Basin. Only a very few of the most notable can be mentioned:

Tarantulas
Family Theraphosidae

California Tarantula
(*Aphonopelma reversum*)

Many local hill residents are understandably shocked to find a giant, hairy spider crawling about their patio on a summer's eve. Few Angelenos realize that tarantulas are permanent inhabitants of the dry, grassy hillsides of the Basin. One species seems to be prevalent, *Aphonopelma reversum.*

Tarantulas usually live in groups, or "colonies," where their presence is revealed by the numerous ground burrows in which they live and lay their eggs. The spiders use their fangs and legs to dig these burrows, which are usually eight inches or more deep and about 1½ inches in diameter at the mouth. Sometimes the spiders utilize existing holes for their homes, such as abandoned rodent burrows or natural cavities under stones. These burrows are always lined at least partially by silk, which both the males and females produce with the two pairs of fingerlike silk organs (spinnerets) located at the terminus of the abdomen. When the tarantula is rearing young or is dormant, it also may web over the mouth of its burrow.

Males and females are identical when immature, and are closely similar even as adults. Mature males may be recognized by the hard, sharp pointed bulb at the end of the pedipalps which is the copulatory organ used in mating; it is absent in the female. Males also have proportionately longer legs, a hooklike appendage underneath the third from the last segment of the front legs, and relatively larger bodies with smaller abdomens than do females. Males frequently have a bald spot on the back of the otherwise very hairy abdomen, a result of the hind legs being frequently rubbed over this area, loosening the hairs and causing them to fly out. Since these hairs are urticating, the action is presumed to be protective, the loosened hairs embedding in and irritating the skin and/or the eyes of an enemy.

Figure 228. California Tarantula, male.

The tarantula is a nocturnal prowler searching for its food, consisting of other small arthropods such as beetles, ground crickets, sowbugs, other spiders, etc. As with all spiders, they kill their prey with poison injected by the large fangs projecting downward from the front end of the body. Though deadly to small creatures, the tarantula's bite is of little consequence to humans, its effect being described as a mildly painful burning sensation accompanied by slight swelling. Furthermore, the spider must be strenuously provoked to cause it to bite.

Because they are really not very poisonous and because their life span is long (females live 12-25 years), tartantulas make interesting pets. They should be kept in a large container with an inch or two of soil along with a bottle cap full of water and a live insect once a week or so for sustenance. Even without food (but with water) this spider may live a considerably long time—up to several months. August-September are good months to search for them as they are then mature, most active and abundant.

It is appropriate here to repeat a curious story originating in the Middle Ages about the word "tarantula." Near the town of Taranta in southern Italy, there was a strange malady called tarantism, erroneousy believed to result from the bite of a large spider. The most conspicuous symptom of the disease was an uncontrollable urge to dance wildly and violently to any light tune, until the dancer was totally exhausted, and at the same time, cured. Rooted in this behavior is the origin of the Tarantella, a lively passionate Neapolitan folk dance.

The wolf spider which supposedly caused tarantism (*Lycosa tarantula*) can be considered the original and "true" tarantula, even though it belongs to the quite different family, Lycosidae. But

it does resemble the spiders we know as tarantulas (Theraphosidae), and thus lost its name to our spiders. A further complication in names results in the use of the generic term *Tarantula* for a group of Old World Whipless Whip Scorpions belonging to an order (Pedipalpida) quite distinct from the spiders.

REFERENCES: Baerg, W. 1958. The tarantula. Univ. Kan. Press, Lawrence.
Woodson, W. 1951. Tarantula–tarantella. Pacific Discovery, vol. 4, pp. 25-28.

Trapdoor Spiders
Family Ctenizidae

California Trapdoor Spider
(*Bothriocyrtum californicum*)

Trapdoor Spiders are novelties in the Basin today, although they were commonplace a few years ago. This is another example of human expansion destroying the habitat of a local animal. The spider prefers to build its nest on sunny hillsides which, in the spring bear a thick covering of short grasses and low herbs. Such areas are becoming increasingly rare in the Basin.

The nest consists of a tube or burrow running vertically into the ground to a depth of 5-8 inches. The walls of the burrow are lined with a thick silken mat, and the ground level entrance is capped with a very tight-fitting lid which is hinged on one side. It opens like a trap door (hence the name of the spider), and has beveled sides fitting into the tube like a cork into a bottle (the common name for this burrow is "cork nest").

The spider, usually a female, since males are somewhat rare, possesses digging spines on its chelicerae and first pair of legs to assist it in its task of excavating the burrow.

Food consists of other terrestrial arthropods, especially ground-dwelling insects happening to pass the nest. Rarely does the spider stray from the immediate vicinity of the burrow opening, usually preferring to "keep one foot in the door." It is said she has a difficult time in opening the trap from the outside and, should it accidentally fall closed in her absence, would be vulnerable to attack from predators until the safety of the burrow could be gained. When the trap is shut the nest is well-camouflaged by bits of soil and surface debris spun into the outer wall of the door to enhance its resemblance to the surrounding terrain.

Figure 229. California Trapdoor Spider: a.—female in base of tunnel nest; b.—appearance of nest from surface, door closed; c.—same, door open.

Like its relative, the tarantula, the trapdoor spider is parasitized by the tarantula hawk spider wasps (*Pepsis* species).

REFERENCE: Passmore, L. 1933. California trapdoor spider performs engineering marvels. Nat. Geogr. Mag., vol. 64, pp. 195-211.

Combfooted Spiders
Family Theridiidae

Western Black Widow
(*Latrodectus hesperus*)

Figure 230. Black Widow Spider, female (upper), male (lower).

The female's occasional practice of devouring the male after mating has earned this species its name.

Sexes differ greatly in appearance: males are small (¼ inch body length), grayish black and variably marked with red and yellow spots and stripes; females are large (1-1¼ inches in body length) with very bulbous, shiny black abdomens. Both sexes usually display a red, hour-glass-shaped spot on the underside of the abdomen, although this and the whole color pattern is varied.

This spider is all too common in the Basin, likely to be found in any cool, dry, protected hideout. Favorite haunts are woodpiles, under houses, in refuse stored in garages and attics, in hollow stumps, etc. The web is without definite form, made of rather coarse silk.

Although they are not at all aggressive, males and females occasionally bite man, often causing serious and even fatal consequences. The venom is reputed to be proportionately 15 times as poisonous as that of the rattlesnake. For this reason, one should be very careful to avoid being bitten and should immediately call a physician should the unfortunate occur. First-aid treatment consists of placing an ice bag on the wound and keeping the patient calm until the doctor arrives.

REFERENCES: Thorp, R. and W. Woodson, 1945. Black Widow, America's Most Poisonous Spider. Univ. North Carolina Press, Chapel Hill.
Kaston, B. 1970. Comparative biology of American black widow spiders. San Diego Soc. Natur. Hist., Trans., vol. 16, pp. 33-82.

Brown Spiders
Family Loxoscelidae

Violin Spiders
(*Loxosceles* species)

Figure 231. Violin spider *(Loxosceles laeta).*

In 1969 the discovery of a population of *Loxosceles laeta* in Sierra Madre stirred public recognition of the "spider menace" in the Los Angeles area. Although there have not been any local cases of a bite from this species or of the closely related *L. reclusa* (which, like *laeta,* is an introduced form), there is evidence that *L. unicolor,* native to the Mojave Desert, has been responsible for a few instances of spider bite resulting in serious consequences. The venom of these spiders acts on the tissues locally, rather than generally on the nervous system, causing a troublesome sore which may spread, and which is so resistant to healing that surgery may be required.

REFERENCE: Keh, B. 1970. *Loxosceles* spiders in California. Calif. Vector Views, vol. 17, pp. 29-34.

Orb-Weavers
Family Araneidae

Common Garden Spider
(*Argiope aurantia*)

Figure 232. Common Garden Spider.

Large size (body often over 1 inch long) and a black abdomen with broad yellow bars along the sides characterize the female of this spider, which is frequently seen hanging upside-down in the center of its large web. The webs are constructed among shrubs and are of the orb type (like a wheel, with radiating strands and concentric circles); below the center there is a zig-zag band of silk (stabilmentum) which apparently helps camouflage the spider whose abdomen is similarly patterned.

The male Common Garden Spider is one-fourth the size of the female, living inconspicuously in a feeble, imperfect web beside that of his mate. The adults mature in mid-summer, when they mate. The female places her eggs in a large pear-shaped cocoon with a brown, paperlike surface. The young hatch during the winter and remain in the cocoon until the following warm days of spring.

Jumping Spiders
Family Salticidae

Red Jumping Spider
(*Phidippus formosus*)

Figure 233. Red Jumping Spider.

The brilliant red abdomen frequently attracts attention to this species in the spring when it is most active. Because of this color, the undiscerning sometimes mistake it for the Black Widow. It is quite different, however, because of its much smaller size (length ⅜ inch), short legs, hairy body and red color. The red covers the entire abdomen and is not restricted to an hour-glass-shaped mark on the under side. The Red Jumping Spider is not considered dangerous, though it may inflict a painful bite to sensitive skin.

This is a hunting spider, and thus does not utilize a permanent web for trapping prey. Adult females do construct a funnel-type web, usually in contact with the soil, used as a retreat and for protection of the eggs. Both sexes spend the daylight hours wandering over the ground and vegetation in search of small invertebrates upon which they may leap from some distance. Because they are so active, they often wander into houses, where they attract immediate attention (and cause undue concern) because of their bright color and rapid movements.

Lynx Spiders
Family Oxyopidae

Green Lynx Spider
(*Peucetia viridens*)

Figure 234. Green Lynx Spider, female.

This conspicuous, large, green spider lives on shrubby plants throughout the warmer, southern parts of the United States. In the fall the female constructs a rounded, light green to straw-colored egg sac, ½ to 1 inch in diameter and flattened on one side. It is usually placed in the upper branches of woody plants and contains 25-600 bright orange eggs. The spiderlings are colored similarly and emerge in about two weeks.

Adults are hunters, springing on their prey from ambush. The latter often consists of moths, but many other kinds of insects are also caught and eaten.

REFERENCE: Whitcomb, W., M. Hite, and R. Eason. 1966. Life history of the green lynx spider, *Peucetia viridens* (Araneida: Oxyopidae). Kansas Entomol. Soc., J., vol. 39, pp. 259-267.

Crab Spiders
Family Thomisidae

Figure 235. Crab Spider *(Xysticus).*

The common name of this family of small spiders refers to the crablike appearance and behavior of the majority of species: the body is flattened and short, and the legs are oriented strongly to the sides, the first two pair being enlarged; they have the ability to move sidewise and backward with facility.

They capture their prey from ambush, without the use of a web. The colors of many species match the flowers they sit on as they wait for visiting flies and bees. Unaware of the spider's presence, they are easily captured. Individual spiders can change their color to mimic perfectly their background, though they cannot deviate greatly from their predominating yellow, bluish or red; the process requires several days.

One of the commonest regional species is *Misumenops californicus.* It is white to bright yellow and most abundant in the spring on garden flowers.

REFERENCE: Schick, R. 1965. The crab spiders of California (Araneida, Thomisidae). American Museum Natur. Hist., Bull., vol. 129, pp. 1-180.

Mites
Order ACARINA

"Mite," meaning tiny, is an apt description of these eight-legged relatives of spiders; indeed, most species are barely visible to the naked eye.

A large number of species is known, and the ranks of the order increase each year with further discoveries. They live in every imaginable habitat. For discussion purposes, it will be useful to divide them into six categories (only one or two important regional species will be listed and discussed for each):

I. Plant-feeding mites
   Spider Mites, Clover Mites
II. Soil inhabiting mites—free living
   Oribatid or Beetle Mites
III. Food infesting mites (occasionally biting man)
   Acarus, Tyrophagus
IV. Nest inhabiting species parasitic on urban birds and rodents and occasionally bothering man.
   Tropical Rat Mites, Mouse Mites
V. Mites parasitic on wild animals and occasionally bothering man
   Chiggers
VI. Species directly parasitic on man
   Hair Follicle Mites, Scabies Mites

REFERENCES: Baker, E. 1956. A manual of parasitic mites of medical or economic importance. Nat. Pest Control Asso., N. Y.
Baker, E. and G. Wharton. 1952. An introduction to acarology. Macmillan Co., N. Y.
Hughes, T. 1959. Mites or the Acari. Athlone Press, London.
MacNay, C. 1963. Control of mites in the home. Canada Dept. Agr., Pub. 934.

Spider Mites
Family Tetranychidae

Figure 236. Two-spotted spider mites, adults and egg.

Spider Mites acquire the name from their habit of spinning fine silken carpets upon the undersides of leaves, where they spend their lives and lay their eggs. The mites themselves are minute, whitish, greenish or reddish, often with faint spots on their backs. They suck the sap of economically important plants and, in our area, are especially injurious to citrus. Infested leaves become blotched and sickly, then gradually die and drop.

Perhaps the most important species is the Citrus Red Mite (also called the Red Spider: *Panonychus citri*), a pest mainly of lemons. Two other injurious species are the Six-spotted Mite (*Eotetranychus sexmaculatus*) on citrus and the Two-spotted Mite (*Tetranychus telarius*) on weeds and cover crops in citrus orchards, sometimes attacking the trees as well. The following species is especially common and noteworthy as a household pest.

Clover Mite
(*Bryobia praetiosa*)

Figure 237. Clover Mite.

Although this mite's external coloring is pale reddish brown, it leaves a conspicuous blood-red stain if crushed. A plant feeder, found on a great variety of herbaceous hosts in the garden, it tends to migrate, readily entering homes where it can create great concern for the housewife. Of nuisance value only, since they do not bite humans, evidence of their passing may deface walls and windowsills following a determined attack by an irate housewife.

The species is less than 1/32 inch long and recognized structurally by very long front legs and featherlike projections on the body.

REFERENCE: United States Department of Agriculture. 1958. Clover mites—how to control them around the home. U.S. Dept. Agr., Leafl. 443.

Acarid Mites
Family Acaridae

Food-infesting Mites
(*Acarus, Tyrophagus*)

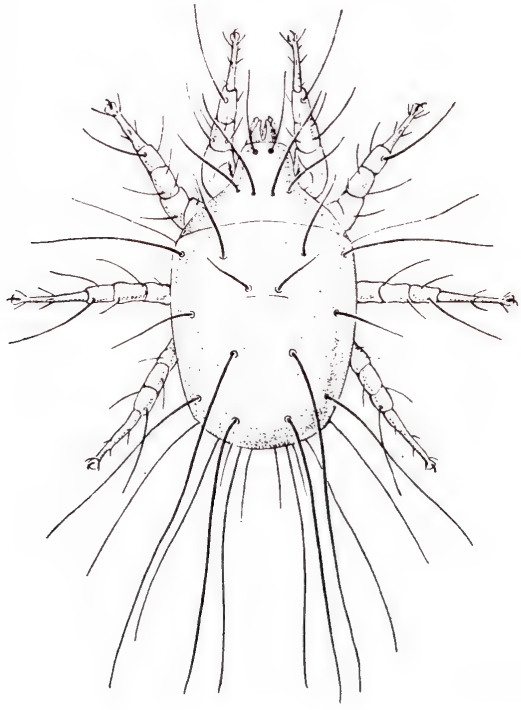


Figure 238. A food infesting mite *(Tyrophagus).* (From Essig, E. and W. Hoskins. 1944. Univ. Calif. Agr. Ext. Ser., Circ. 87, fig. 135)

Very small (less than 1/64 inch), colorless and covered with long, spinelike hairs, these mites commonly infest stored and dried food materials, sometimes straying to stuffed furniture, mattresses and pillows. They may be present in such quantities that food and mites form a single moving mass.

Occasionally their bite causes an itching irritation called "grocer's" or "baker's itch."

Parasitic Mites
Family Dermanyssidae

Tropical Rat Mite
(*Ornithonyssus bacoti*)

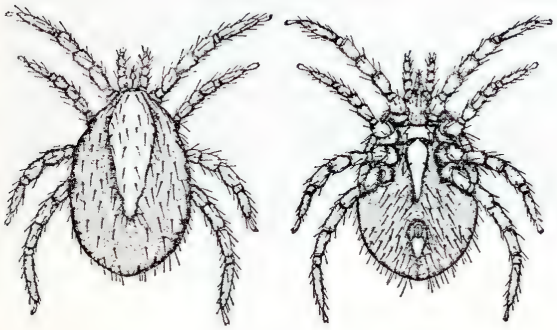


Figure 239. Tropical Rat Mite, dorsal (left), ventral (right). (From Shelmire, B. and W. Dove. 1931. Jour. Amer. Med. Assoc., vol. 96)

The usual host of this parasitic blood sucking mite is the Domestic Rat, but it also infests urban birds (pigeons), in whose nests it may be found in large numbers. On occasion, particularly after the animal hosts are eliminated from the premises, these mites may attack humans, causing itching inflammations with their bites. They bite primarily at night and may migrate to warm places indoors (near water heaters, hot water pipes) after feeding.

The species is pale grayish yellow in color and slightly over 1/32 inch long. Its occurrence in the Basin is sporadic.

This is one of several widespread parasitic mites which may attack man; others are difficult to distinguish except by the specialist.

Mouse Mite
(*Allodermanyssus sanguineus*)

The most obvious difference between this and the preceding species is that this mite has two back plates rather than one. It is a blood sucking parasite of house mice and domestic rats and, therefore, may infest homes, occasionally biting man. Outbreaks of Rickettsial pox, a mild human disease similar to Chicken pox, have been traced to this mite in other parts of the country. The House Mouse has acted as a reservoir of the disease, with the mite acting as the vector to transmit it to humans.

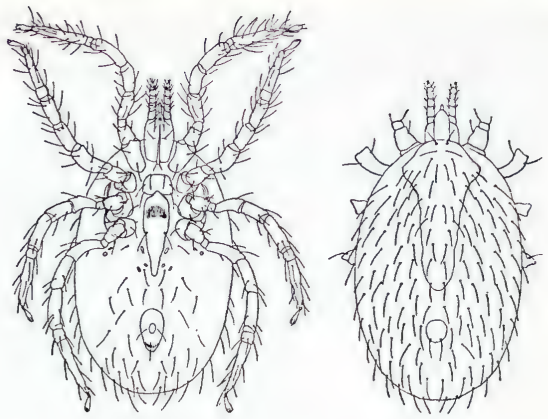


Figure 240. Mouse Mite. (From Hirst, S. 1914. B. Entomol. Res., vol. 5:220)

Chiggers
Family Trombiculidae

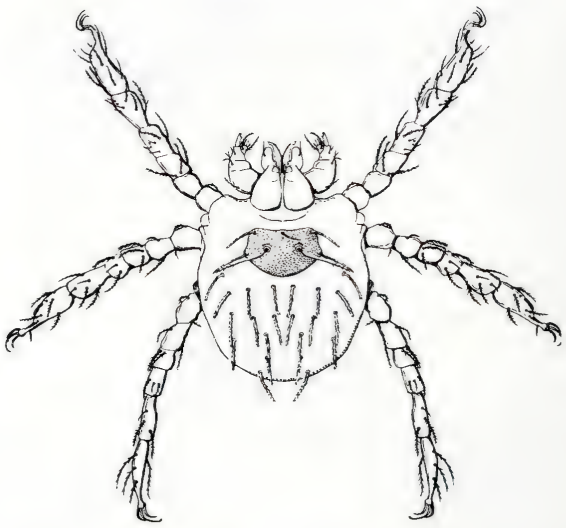


Figure 241. A chigger *(Trombicula belkini).* (From Gould, D. 1950. Wasmann Jour. Biol., vol. 8:368)

Chiggers, or "Red Bugs" as they are often called, are not as great a problem locally as in more humid climates. Nevertheless, there are two pestiferous species in the Basin which occasionally attach to man, causing the typical itching welts known so well by southerners and mid-westerners. Belkin's Chigger (*Eutrombicula belkini*) and the Common Chigger (*E. batatas*) occur in the foothills of the San Gabriels, Palos Verdes Hills and in our other wild areas. Lawns about homes and in parks are frequent sites of attack. The former species normally infest lizards; the latter, birds and small mammals—man is only an accidental host.

The chigger does not burrow into the skin as commonly believed, but attaches only with the mouthparts. Furthermore, the chigger does not suck blood. When firmly attached it injects a digestive fluid from its salivary glands into the skin causing a disintegration of the surrounding cells. The resultant fluid is then ingested. The irritating action of this digestive fluid may persist for some time after the mite has been removed or has dropped off. Chiggers do not transmit any human diseases in our area, but they do act as serious vectors, especially of Scrub Typhus, in parts of Asia.

The irritating chigger is the parasitic larval stage of this family of otherwise free living, terrestrial mites. Adults are relatively large (1/16 inch long compared to the less than 1/64 inch of the larvae), and are conspicuously covered with a dense, furry coat of bright red or orange feathery hairs. Like the nymphs, which are somewhat similar in structure, they live on or in loose soil and feed on the eggs of other small terrestrial arthropods, probably most often those of springtails.

In addition to the pest species mentioned above, several others, especially in the genera *Euschoengastia, Neotrombicula,* and *Odontacarus,* occur locally. Their larval hosts are mainly lizards and small mammals.

Follicle Mites
Family Demodicidae

Hair Follicle Mite
(*Demodex follicularum*)

This extremely minute arthropod lives, of all places, in the follicle of human hair. Here is goes unnoticed, no doubt, in a fairly high percentage of the population, since its presence is unfelt and causes no ill symptoms. It does not cause blackheads and pimples.

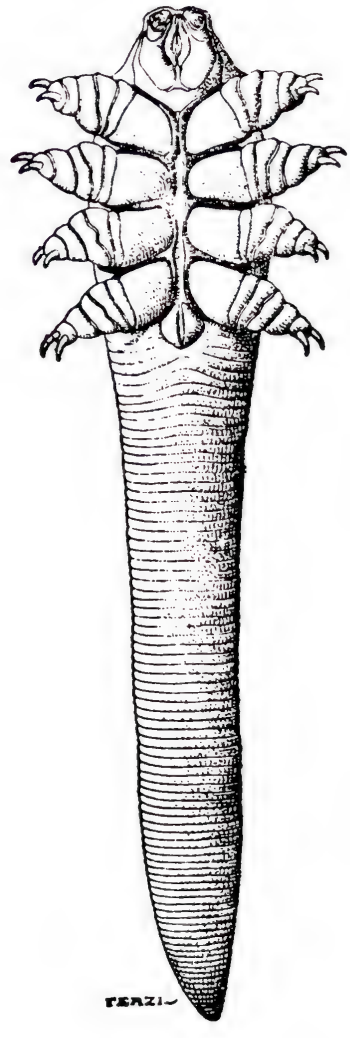


Figure 242. Hair Follicle Mite. (From Castellani, A. and A. J. Chalmers. 1919 (Third edition). Manual of Tropical Medicine)

Peculiar to this mite, in addition to its extremely small size (1/10 millimeter long), are its elongate, wormlike body and practically nonexistant legs.

Closely related species are found in the hair follicles of dogs, cats, horses, cattle and other mammals.

Pyroglyphid Mites
Family Pyroglyphidae

House Dust Mites
(*Dermatophagoides* species)

Figure 243. House dust mite (*Dermatophagoides farinae*). (Photo courtesy G. Wharton, Ohio State University)

In recent years the role of certain mites in allergies erroneously attributed to house dust has been appreciated. A normal habitat of various species in the genus *Dermatophagoides* seems to be accumulations of dust in human living quarters. They can be inhaled with dust and may generate severe allergic reactions in sensitive persons.

The mites are extremely small (less than two-hundredths of an inch long) and pale colored. Because of their small size and color they are virtually invisible. Their food consists of bits of organic detritus, such as dandruff, dead flakes of skin etc., mixed with the dust.

REFERENCE: Spieksma, F. and M. Spieksma-Boezeman. 1967. The mite fauna of house dust with particular reference to the house-dust mite *Dermatophagoides pteronyssinus* (Trouessart, 1897) (Psoroptidae: Sarcoptiformes). Acarologia, vol. 9, pp. 226-241.

Skin Mites
Family Sarcoptidae

Scabies Mite
(*Sarcoptes scabiei*)

The cause of human scabies, these mites burrow into the horny layer of the skin and produce an

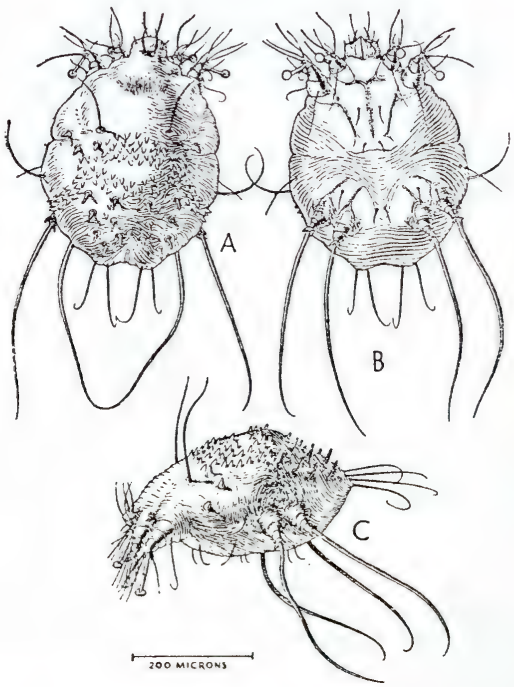


Figure 244. Scabies Mite. (From Mellanby, K. 1943. Scabies, fig. 1)

intense itching sensation. Skin between the fingers, the inner area of the knee and elbow, the genitals, breasts and shoulder blades are the usual areas infested although any part of the body is vulnerable. At first, this may be mild, but serious mange may develop when aggravated by scratching and secondary infection.

The mites themselves are tiny (less than 1/64 inch long), nearly round in outline and usually difficult to find even when involved with the symptoms just mentioned. The species is of very sporadic occurrence in the Basin, usually manifesting itself only under crowded or unsanitary conditions.

REFERENCE: Mellanby, K. 1943. Scabies. Oxford Univ. Press, London.

Soil Mites
Group ORIBATEI

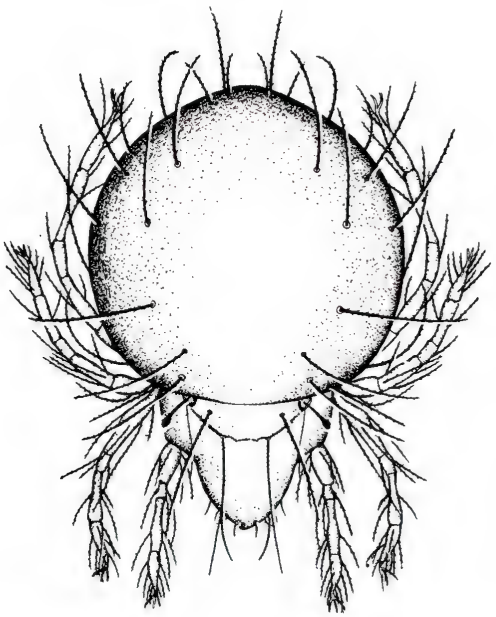


Figure 245. Soil mite *(Notaspis pectinata).* (From Cox, F., P. Jahraus, and W. Moore. 1921. J. Ent. Zool., Pomona Coll., vol. 13:31)

Making up a large percentage of the fauna of humic soils, Oribatid or "Beetle" Mites are abundant wherever leaf litter and deep soils occur in the Basin. They are important in promoting soil fertility through their digestion of organic matter, but little else is known of their biology.

The group is characterized by a hard, dark integument and often heavily-plated body, sometimes with winglike expansions on its sides. Most of them look like bird seed with legs. An additional recognition feature is the separated anterior portion of the body covering the head region, which is frequently jointed to the remainder of the thorax-abdomen.

There are numerous species in the Basin, particularly in mountain canyons. To attempt their identification would be impractical; certainly some are unknown even to science.

Ticks
Order ACARINA, Suborder IXODIDES

There are two general types of ticks: Hard Ticks and Soft Ticks. The Hard Ticks (Family Ixodidae), also known as Wood or Seed Ticks, characterized by a thick, leathery scutum or plate on the back; in the male, this plate completely covers the back and is often ornamented with a harlequin pattern of light (frequently silvery) and dark areas; the plate is reduced in the female and covers only a small region in back of the "head." In the Soft Ticks (Family Argasidae), both sexes lack this plate, and as a result the whole body is a pliable bag.

Females of both general types are capable of unbelievable distention during the course of feeding on blood. An unfed individual the size of an apple seed may, after engorging, swell to the size of a grape.

Ticks differ from insects in that the body is undivided; it is a simple saclike structure due to the fusion of the thorax, abdomen and part of the head. There is no true head, but there are mouthparts and sometimes a small associated structure at their base. Furthermore, mature ticks and nymphs bear four pairs of legs, although the larvae have six legs, which could lead to confusion with some insects.

Ticks in all stages feed on the blood of vertebrates, but, like most other ectoparasitic arthropods they spend only a portion of their life on the host. Fully engorged females usually drop to the ground where they deposit their eggs. Six-legged larvae hatch from the eggs and attach themselves to the first suitable host coming within their reach. After feeding, they drop to the ground and transform into eight-legged nymphs. Following one to five molts, each requiring engorgement on a host, the nymphs mature. As in the case of immature stages, new adult, unfed ticks again seek a passing host by climbing to the tips of blades of grass or brush

twigs, where they await passing animals. These ticks are aroused by vibration or movement of their perch, causing them to wave their legs in the air, groping for a lucky grab at a passerby.

Ticks frequently attach themselves to humans and can cause harm. The area around the bite may become very sensitive or painful, and paralysis can occur. Symptoms subside after removal of the tick, although in the case of the Pajaroello, tissue may decay causing a severe wound to develop. No disease is known to be transmitted by ticks in the Basin proper, but a spirochaete disease, called Relapsing Fever, carried by a species of soft tick, occasionally breaks out in the nearby mountains.

The California Department of Public Health recommends the following procedure for removal of an attached tick:

"—Use a pair of flat-tipped tweezers or a piece of paper. These are recommended because the engored tick may carry the disease organisms of tularemia which can penetrate the unbroken skin.

—Grasp the body of the attached tick with tweezers or paper and exert a straight, steady pull. It may take some time before the tick releases its hold.

—Application of a small amount of kerosene sometimes makes it easier to remove the tick.

—Apply an antiseptic to the area of the bite. Washing with soap and water will serve the same purpose.

—See your physician if you are unable to completely remove the tick.

—Report to your physician should you become ill following a tick bite.

—Vaccination as protection against Rocky Mountain Spotted Fever is recommended only for those people who are frequently exposed to ticks in heavily infested areas where this disease occurs. There are no vaccines available to the public for the prevention of the other tick-borne diseases."

Ticks are very hardy creatures and may survive for months or years without food.

Following is a partial list of the major local tick species:

Figure 246. A hard tick, the Western Wood Tick: a.—male, b.—female.

Hard Ticks

1. Pacific Coast Tick (*Ixodes pacificus*).

A small species with a dull reddish body usually found on deer. Its bite is painful.

2. Western Wood Tick (*Dermacentor occidentalis*).

On various hosts including man.

3. American Dog Tick (*D. variabilis*).

A pest of dogs.

4. Brown Dog Tick. (*Rhipicephalus sanguineus*).

Another pest of dogs, locally more common than the preceding.

5. Rabbit Tick (*Haemaphysalis leporispalustris*).

A small species often on rabbits. Rarely bites man.

Soft Ticks

1. Pajaroello (*Ornithodorus coriaceus*).

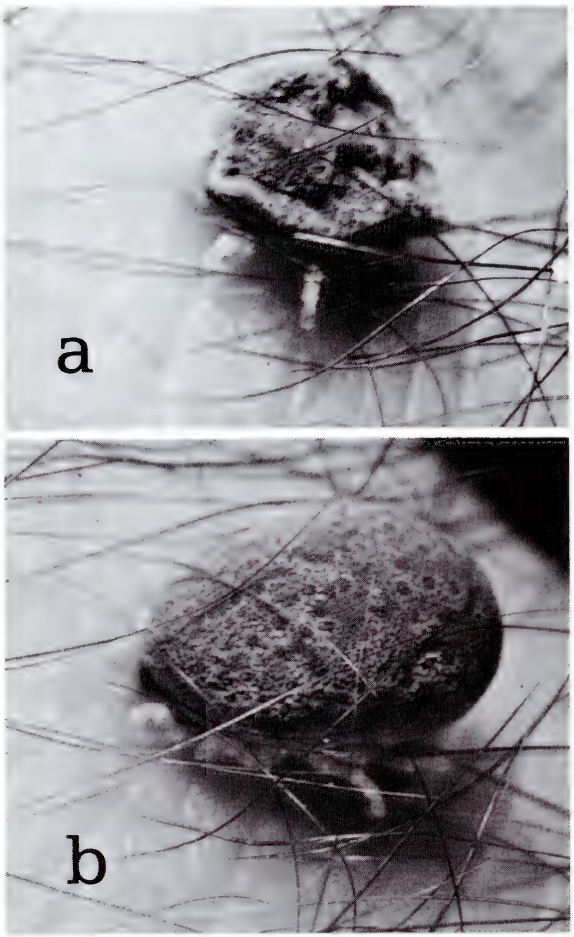


Figure 247. A soft tick, the Pajaroello: a.—unfed, b.—same specimen after engorgement.

Capable of causing a very serious bite—see above. Found in chaparral areas.

2. Fowl Tick (*Argas persicus*).

A very flat tick found on chickens and other fowl.

REFERENCES: California State Department of Public Health. 1963. Wood ticks in California. Calif. State Dept. Pub. Health, Berkeley.

Waldron, W. 1962. Notes on the occurrence, observations, and public health significance of the pajaroello tick—*Ornithodorus coriaceus* Koch in Los Angeles County. So. Calif. Acad. Sci., Bull., vol. 61, pp. 241-245.

Centipedes
Class CHILOPODA

Although the word means "100-legged," no centipede can have exactly that number, since there is always an odd number of pairs of legs. Ranging from 31 to well over 200, the legs are clearly distributed, one pair per segment, an arrangement distinguishing centipedes from millipedes. In millipedes the legs appear in double pairs, with four legs arising from each apparent body segment.

Centipedes are nocturnal and carnivorous, hunting at night for other small creatures which they subdue with a dose of poison administered by a pair of fangs, which are actually modified front legs. During the day, they hide in damp, dark, obscure places—under stones and bark, in leaf litter, rotten logs and in cracks and crevices in the soil.

Though their poison is lethal to their small prey, there is no evidence that the bites cause more than mild discomfort to humans, except in the case of the largest species.

REFERENCE: Chamberlin, R. 1910-1912. Chilopoda of California. Pomona Coll. J. Entomol., vol. 2, pp. 363-374; vol. 3, pp. 470-479; vol. 4, pp. 651-672.

An undetermined number of species occur in the Basin. The most common and conspicuous are these:

House Centipede
(*Scutigera coleoptrata*)

Figure 248. House Centipede.

About an inch long, this centipede is very distinctive because of its very long, slender legs, of which there are only 15 pairs, the last pair much longer than the rest (in the female they are twice as long as the body). The entire body is exceedingly frail and pale translucent-bluish in general color.

The species is very active and moves rapidly in its attempts to escape capture and to snatch the

small insects it requires as food. Specimens are commonly found indoors, darting across the floor or clinging to a wall. They are particularly fond of damp basements.

It is doubtful if this centipede can even inflict a wound to the human skin, so it should not be considered dangerous but actually beneficial in that they prey on many insect housepests.

Multicolored Centipede
(*Scolopendra polymorpha*)

Figure 249. Multicolored Centipede.

This is a large centipede, attaining a maximum length of about 7½ inches. It varies in color from clear or dark olive yellow to olive brown, the rear borders of the back plates mostly dark green.

Practically nothing is known about its biology, other than that its general habitat is the same as for most centipedes—secluded places in contact with logs, rocks or the ground.

The bite of this species may be very painful; there is no objective data on the effects of its poison on humans. Contrary to popular belief, the sharp claws on the legs are not poisonous, although the last pair of legs is capable of pinching.

Millipedes
Class DIPLOPODA

Figure 250. A common millipede *(Hiltonius).*

The word "Diplopoda" means "double-footed," and refers to the two close-set pairs of legs on each apparent segment of these wormlike arthropods. Actually, each body division consists of two coalesced true segments with confluent back plates.

Millipedes prefer moist conditions, and they abound in damp leaf litter, under rocks, logs and loose bark, though in their nocturnal wandering they may be seen climbing on tree trunks or rocky cliffs; when the weather is cold or dry they burrow into the ground. Their food consists of humus, rotting leaves, wood, and bark.

If disturbed or taunted, they coil up like a watch spring; many species also exude fluids which stain the skin and have a repugnant odor variously compared to iodine, quinine, or chlorine. The fluids commonly are benzoquinones and other chemicals which evaporate rapidly and act as a repellant against predators. Certain millipedes even produce cyanide fumes.

Very little is known about the biology of these interesting creatures. They are easily collected in the habitats listed above, especially after rains; a few are luminescent and others fluoresce in the presence of ultra-violet light making them easy to find at night wiith an ultraviolet or black light. Tightly closed jars containing several handfuls of moist humus are useful in keeping captive specimens.

Several species live in the Basin; most are small and inconspicuous except for the closely related *Hiltonius pulchrus* and *Tylobolus claremontus,* which are very large (exceeding 3 inches long). *Atopetholus angelus* is slightly smaller (no more than 1½ inches). All are otherwise similar, with a cylindrical, shiny black, dark gray or brown body. Smaller (½-¾ inch) and less conspicuous but very common is the garden milliped, *Litistriatus hesperus.*

REFERENCE: Keeton, W. 1960. A taxonomic study of the millipede family Spirobolidae (Diplopoda: Spirobolidae). Amer. Entomol. Soc., Mem., vol. 17, pp. 1-146, pls. 1-18.

Crustacea

Order ISOPODA

Sowbugs and Pillbugs

Figure 251. Common Pillbug (left) and Dooryard Sowbug (right).

Very common in damp places around the yard, sowbugs and pillbugs are considered a nuisance by gardeners and householders. The two local species can be distinguished easily:

1. Common Pillbug (*Armadillidium vulgare*). So-called because of its habit of rolling up into a tight ball when disturbed.
2. Dooryard Sowbug (*Porcellio laevis*). Grows considerably larger than the preceding (up to ½ inch) and has two prominent taillike appendages; it is incapable of rolling into a ball.

Both kinds feed on young and decaying plant material and, unless very numerous, do little damage except perhaps to tender seedlings.

Order AMPHIPODA

House Hopper
(*Talitrus sylvaticus*)

Householders in various parts of Los Angeles County have been startled by the appearance of

Figure 252. House Hopper.

these small, red, shrimplike terrestrial crustaceans. Always found dead, they are a nuisance merely by their presence. Infestations characteristically follow rainy periods. It is likely these animals seek the dryness of indoors when their natural habitats are flooded. Ivy ground cover and leaf mold beneath shrubbery apparently offer suitable conditions for development.

REFERENCE: Mallis, A. 1942. An amphipod household pest in California. J. Econ. Entomol., vol. 35, p. 595.

of these beetles occur no closer to Los Angeles than Southern Arizona.

REFERENCE: Stock, C. 1963 (Sixth edition). Rancho La Brea, A Record of Pleistocene Life in California. Natur. Hist. Mus. Los Angeles County, Sci. Ser. 20. (See especially pp. 66-67.)

PREHISTORIC

INSECTS

A particularly fine record of insects living in a portion of the Basin 40-10,000 years ago (upper Pleistocene geologic period) is preserved in the famous La Brea "Tar Pits" located at Rancho La Brea in Hancock Park on Wilshire Boulevard, West Los Angeles. Thousands of specimens have been extracted from the asphalt deposits, in company with the bones of sabre toothed cats, giant ground sloths and mammoths.

On the basis of their ecology, the following are the most common types of insects found at this site.

1. Aquatic beetles (Hydrophilidae, Dytiscidae) and bugs (Notonectidae, Belostomatidae).

Water must have stood on the asphalt pools for long periods, supporting a rich aquatic insect fauna. As the pools dried up, many species were unable to escape and became trapped in the underlying matrix.

2. Carrion beetles (Silphidae) and flies (Sarcophagidae, Calliphoridae).

Often found within the bones of the vertebrate fossils, these insects fed upon the decaying corpses of birds and mammals trapped in the pits, and their occurrence demonstrates that entombment at Rancho La Brea was, at times, a slow process.

3. Ground dwelling beetles (Carabidae, Tenebrionidae).

There can be little doubt that these insects became trapped in the sticky asphalt during the course of their terrestrial wanderings.

Well over 100 species of various insects and related terrestrial arthropods have been identified from the La Brea deposits, and many more are certain to come to light as the material is studied by paleoentomologists. Most are near relatives, or the same species of modern residents of the Basin. A few are extinct, however, notably dung scarabs (*Canthon, Copris, Onthophagus*), which must have utilized as food the leavings of the abundant mammals living near the pools. Today, close relatives

INSECT PESTS IN THE BASIN

Unwelcome guests within our homes, sharing our food and possessions and sometimes repaying us with bites and stings—these are the insect pests. It is convenient to recognize four categories here: Household Pests; Garden Pests; Agricultural and Veterinary Pests; and Health Pests.

I. Household Pests

A need for shelter, food or a nesting place, attraction to lights or perhaps the enticement of shade and food odors—not the apparent conscious desire to bother us—bring these guests to our door. In spite of screening, entry is easy for most insects; their small size permits them to squeeze through small cracks in the flooring, around baseboards, under doors and through minute imperfections in construction. There are several kinds of household pests.

A. *Fabric pests:* The principal offenders here are the *carpet beetles* and *clothes moths*. Larvae of both normally utilize animal hair and skin as food, making no distinction between dead carrion in the out-of-doors and a fur coat or wool sweater hanging in a closet.

Usually only natural products are eaten such as wool, cotton and silk, but occasionally synthetics such as nylon and rayon are attacked. Mixed weaves of natural and synthetic fibers are more susceptible. Fabrics stained with certain foods are especially attractive to these pests.

References: Mallis, A. et al. 1958. Feeding of four species of fabric pests on natural and synthetic textiles. J. Econ. Entomol., vol. 51, pp. 248-249.
Mallis, A. 1959. The attraction of stains to three species of fabric pests. J. Econ. Entomol., vol. 52, pp. 382-384.

B. *Wood and paper pests:* Several kinds of insects, most notably the termites, larvae of several wood boring beetles, cockroaches and silverfish, eat and digest cellulose in its original wood form or as man-modified paper.

Wood, in the structural support of the house, may be eaten away to such an extent it no longer can perform its function, resulting in expensive damage. Hardwood furniture, paneling or picture frames may be riddled. Wallpaper, paper keepsakes and books may be shredded or mined out.

C. *Pantry pests:* Two categories of insects are unwanted additives of stored food, *pantry moths* and *pantry beetles*. Damage is primarily to dried food products, but occasionally fresh fruit or vegetables may be ruined by fly maggots or beetle grubs which really belong to the out-of-doors rather than to the household.

Reference: Anonymous. 1953. Stored grain pests. U.S. Dept. Agric., Farmers' Bull. 1260.

D. *Annoyances:* The housewife will not hesitate to place in this group any creeping, crawling creature which graces her doorstep. No one enjoys a cockroach running across his face at night, nor truly appreciates the persistent fly buzzing about his ear. Insects which cause no real damage or harm but are simply undesirable house guests are annoyances. In addition to those mentioned, there are also gnats, owlet moths, Jerusalem crickets, spiders—and many species join the category as man invades new realms in his real estate ventures.

Reference: Pence, R. 1955. Is new home construction upping the invasion of 'strangers'? Pest Control Mag. vol. 23, no. 10, pp. 30f.

II. Garden Pests

What devotee of gardening, the popular hobby of many Southern Californians, has not felt his ardor dampened upon finding his prize roses curled under masses of aphids, or his tomato vines denuded by giant green caterpillars?

A wide variety of insects prey on ornamental, fruit and vegetable plants. They may be classified into two groups according to their method of feeding:

A. *Chewing insects*: With mandibulate mouthparts, these pests literally consume the solid matter of garden plants. Cutworms, grasshoppers, grubs, weevils, stem borers and the like, belong here.

B. *Sucking insects*: Piercing mouthparts rob plants of their vital sap. Aphids, scale insects, mealybugs, leafhoppers and their kind are of this type.

Reference: Michelbacher, A., J. Swift, C. Davis, D. Hall, and R. Raabe. 1959. Ridding the garden of common pests. Calif. Ag. Exp. Sta. Ext. Service Circ. 479.

III. Agricultural and Veterinary Pests

In the face of the rising tide of urban sprawl, agricultural acreage is steadily diminishing in the Los Angeles Basin. Yet dairy, citrus, truck crop, nursery stock and cut flower farming still occupy a surprisingly broad total territory. Basin agriculture contributes substantially in maintaining Los Angeles County's position within the top 10 in the United States, as measured by total crop harvest and the value of livestock production.

It would be impossible to characterize here all the pests of green crops, even in our limited area. In general, they are of the same types as garden pests, chewing and sucking, and many species are found in both fields and gardens. We are fortunate at least in not having locally some of the infamous offenders of eastern farms, such as the Mexican Bean Beetle (*Epilachna varivestis*); Migratory Locusts (*Melanoplus*); European Corn Borer (*Ostrinia nubilalis*); Mormon Cricket (*Anabrus simplex*); Colorado Potato Beetle (*Leptinotarsa decemlineata*); Japanese Beetle (*Popilia japonica*) and Gypsy Moth (*Porthetria dispar*).

Dairy cattle, horses, swine, poultry, etc. suffer the attack of many parasitic and blood sucking insects. Veterinary practice must still deal with these pests, although modern insecticides and drugs render their effects much less severe than in the past.

IV. Health Pests

This category may be subdivided to separate those which inflict us with direct bodily injury (*direct agents*) and those acting as vectors of pathogenic microorganisms (*disease vectors*).

Locally, there are many within the first group which sting us (bees, ants, wasps, scorpions), bite us (spiders, centipedes, horseflies, cone-nose bugs, ticks) or burrow into our skin and bodies (scabies mites, flesh flies). Stings and bites are seldom serious unless the venom injected is very toxic (primarily in the case of the Black Widow Spider) or capable of eliciting a shock reaction in sensitive individuals (Western Cone-nose Bug).

Fortunately, few active disease vectors live in our region. Occasionally there are cases of Encephalitis resulting from the bite of mosquitoes infected with the virus; Relapsing Fever, carried by the soft tick *Ornithodorus hermsi* in neighboring mountains; and Murine Typhus transmitted by fleas.

Fleas may also act as vectors of Plague, which is latent in our wild rodent population. Even Malaria remains a potential threat to our local health and welfare. Though rare, *Anopheles* mosquito vectors live in the Basin and are capable of fostering the disease should it be introduced by an infected human from abroad.

The local status of Chagas Disease is puzzling. Microorganisms, apparently identical to those causing symptoms in the tropics but without the virulence to do so, exist here in wild rodents and in the Western Cone-nose bug, and so must also be classified as a latent disease.

The comfort of many is destroyed by pesky insects and mites whose bites are not venomous but which cause itching welts and skin rash (mosquitoes, lice, bed bugs, black-flies, punkies). No clear-cut evidence of insect involvement is present in some cases of skin rash, and the condition is frequently psychosomatic. Intense emotional upset over imagined "bug infestations" characterize the mentally ill (delusory parasitosis).

Reference: Waldron, W. 1963. Psychiatric and entomological aspects of delusory parasitosis. Amer. Med. Asso., J., vol. 186, pp. 213-214.

INDEX

PART I. INDEX TO INSECT SPECIES

Abedus indentatus, 49
Acheta domestica, 29
Acrea Moth, 71
Acrididae, 27
Adalia bipunctata, 117
Aedes sierrensis, 95
Aegeriidae, 79
Aeschna multicolor, 26
Agapostemon, 138
Agraulis vanillae, 82
Agrotis ipsilon, 66, 68
Agulla species, 56
Aleyrodidae, 55
Alfalfa Looper, 68
Allograpta, 98
American Cockroach, 33, 34
American Locust, 29
Anacamptodes fragilaria, 76
Anagasta kuehniella, 78
Anasa tristis, 45
Andricus californicus, 136
Anise Swallowtail, 81
Anisolabis maritima, 27
Anisoptera, 25
Anobiidae, 114, 123
Anobium punctatum, 123
Anopheles franciscanus, 96
Anopheles freeborni, 96
Anoplura, 42
Ant Lions, 57
Antheraea polyphemus, 61
Ants, Bees and Wasps, 126, 127
Aonidiella aurantii, 54
Aphididae, 53
Aphids, 53
Aphis lions, 57
Apantesis ornata, 73
Apantesis proxima, 73
Apidae, 139
Apis mellifera, 140
Arachnis picta, 71
Archilestes californica, 26
Arctiidae, 70
Arenivaga spp., 35
Argentine Ant, 128, 129
Argis, 26
Army Cutworm, 66, 68
Armyworm, 67, 68
Ashy Gray Ladybird, 116, 117
Asilidae, 100
Assassin Bugs, 47
Augachlorella, 138
Autographa biloba, 69
Autographa brassicae, 68
Autographa californica, 68
Back Swimmers, 49
Bee Flies, 101
Beet Armyworms, 67, 68
Beetles, 109
Bembix occidentalis, 134
Bibio albipennis, 97
Bibionidae, 97
Big Black Horse Fly, 98
Big Red Skimmer, 25
Biting Gnats, 96
Blaberus craniifer, 34
Black Blow Fly, 104
Black cutworm, 66, 68
Black Flies, 96
Black Witch, 69
Blatella germanica, 34
Blatella vaga, 35
Blatta orientalis, 34
Blattaria, 33
Blow flies, 104
Blue Bottle Flies, 104
Blue Milkweed Beetle, 125
Blues, Coppers, and Hairstreaks, 90
Bodega Gnat, 96
Bogus Yucca Moths, 79
Bombardier Beetles, 111
Bombus, 139
Bombus californicus, 140
Bombus crotchii, 140
Bombus sonorus, 140
Bombus vosnesenskii, 140
Bombycidae, 62
Bombyliidae, 101
Bombylius major, 101
Bombyx mori, 62
Book Louse, 42
Bookworms, 114, 115
Bordered Plant Bug, 47
Bostrichidae, 122
Brachinus, 111
Brachynemurus, 58
Brachyrhinus cribicollis, 126
Brephidium exilis, 90
Brincadores, 77
Brown Lacewings, 57
Brown Leatherwing, 118
Brown-banded Cockroach, 33, 35
Broad-winged Katydid, 31
Brush-footed Butterflies, 82
Bubonic Plague, 108
Buckeye, 85
Buenoa omani, 50
Buenoa scimitra, 50
Bumble Bee Robber Fly, 100
Bumble Bees, 138, 139, 140
Butterflies, 59, 80
Cabbage Looper, 68
Cactus fly, 99
Caddisflies, 58
Callibaetis, 23, 24
Calico Back, 45
California Archilestes, 26
California Bumble Bee, 140
California Camel Cricket, 32
California Carpenter Bee, 138
California Dobson, 56
California Dog-face, 89
California Gallfly, 136
California Harvester Ant, 129
California Ladybird Beetle, 116, 117
California Oak Moth, 73
California Mantid, 37
California Prionus, 123
California Red Scale, 54
California Ringlet, 87
Calif. Rose-winged Grasshopper, 28
Calliphora vicina, 104
Calliphoridae, 104
Callirhytis pomiformis, 136
Calosoma semilaeve, 110
Camel Cricket, 32
Camponotus clarithorax, 131
Camponotus maccooki, 131
Camponotus vicinus, 131
Cantharidae, 118
Cantharis consors, 118
Carabidae, 109
Carolina Mantid, 36
Carpenter Ants, 131
Carpenter Bees, 138
Carpet Beetles, 121
Caseworms, 58
Cat flea, 108
Catocala irene, 70
Ceanothus Silk Moth, 60
Cediopsylla inaequalis, 109
Cerambycidae, 123
Ceratitis capitata, 106
Ceratopogonidae, 96
Cercopidae, 51
Ceuthophilus californianus, 32
Chacho, 32
Chalcedon Checker-spot, 85
Chicken Body Louse, 44
Child of the Earth, 32
Chilocorus bivulnerus, 117
Chincha, 46
Chinese Mantid, 36
Chironomidae, 97
Chlaenius, 111
Chocolate Looper, 69
Chorizagrotis auxiliaris, 66, 68
Chrysididae, 135
Chrysochus auratus cobaltinus, 125
Chrysopa oculata, 57
Cicadidae, 51
Cicindela oregona, 109
Cicindelidae, 109
Cigarette Beetle, 114
Cimex lectularius, 48
Cimicidae, 48
Clear-winged Moths, 79
Click Beetles, 113
Cluster Fly, 104
Coccidae, 54
Coccinella californica, 117
Coccinellidae, 115
Cockroaches, 33
Codling Moth, 77
Coenonympha california, 87

Coleoptera, 109
Colias eurydice, 89
Colias eurytheme, 89
Collembola, 22
Columbicola columbae, 43
Commercial-wood Boring Beetles, 122
Common Bedbug, 48
Common Blow Fly, 104
Common Calosoma, 110
Common Crane Fly, 93
Common Green Lacewing, 57
Common Hair-streak, 91
Common June Beetles, 120
Common Milkweed Bug, 46
Common silverfish, 22
Common sulfur, 89
Common Toad Bug, 50
Common water strider, 50
Common White, 88
Convergent Lady Beetle, 116, 117
Cool Weather Mosquito, 95
Cootie, 43
Coreidae, 45
Corixidae, 50
Corizidae, 46
Corn Earworm, 65
Corrodentia, 42
Cotinus texana, 120
Cottony Cushion Scale, 54
Crab Louse, 43
Crane Flies, 93
Crickets, 29
Crotch's Bumble Bee, 140
Cryptolaemus montrouzieri, 117
Ctenocephalides canis, 108
Ctenocephalides felis, 108
Ctenolepisma urbana, 22
Cuban Cockroach, 33, 35
Cuckoo Wasps, 135, 136
Culex erythrothorax, 95
Culex peus, 95
Culex quinquefasciatus, 95
Culex tarsalis, 94, 95
Culicidae, 94
Culiseta incidens, 95
Culiseta inornata, 95
Curculionidae, 125
Cuterebra latifrons, 104
Cuterebra lepivora, 105
Cuterebra tenebrosa, 105
Cuterebridae, 104
Cynipidae, 136
Cynthia anabella, 84
Cynthia cardui, 83
Cynthia virginiensis, 84
Damselflies, 24, 26
Danaus plexippus, 82
Dark-sided Cutworm, 66, 68
Dasymutilla, 135
Death's Head Roach, 34
Deer Louse Flies, 107
Dermaptera, 26
Dermestid Beetles, 121
Dermestidae, 121
Desert Locust, 29
Devil's Coach Horse, 113
Devil's darning needles, 24
Diabrotica undecimpunctata undecimpunctata, 125
Diamanus montanus, 109
Diptera, 92
Dissosteira pictipennis, 28
Dog Flea, 108
Domestic Flies, 102
Domestic Silk Moth, 62
Doodle bugs, 58
Dragonflies, 24
Drone Fly, 98
Drosophila melanogaster, 105
Drosophilidae, 105
Drug Store Beetle, 114
Earwigs, 26
Echidnophaga gallinacea, 109
Edward's Glassy-wing, 72
Elateridae, 113
Eleodes, 118
Elliptic Water Scavengers, 112
Enallagma, 26
Ephemerida, 23
Ephydridae, 106
Erebus odora, 69
Ergates spiculatus, 123
Eristalis tenax, 98
Erynnis funeralis, 92
Estigmene acrea, 71
Euborellia annulipes, 27
Eucalliphora lilaea, 104
Euphydryas chalcedona, 85
Eurema nicippe, 88
European Earwig, 27
European Blue Bottle Fly, 104
European Cabbage Butterfly, 87
European Mantid, 36
Euxoa messoria, 66, 68
False Bombardiers, 111
False Stable Fly, 103
Fannia canicularis, 103
Feltia subterranea, 67, 68
Field cockroach, 33, 35
Field Cricket, 30
Field Mosquito, 96
Fiery Skipper, 91
Fig Beetle, 120
Fire Brat, 22
Fire-spotted Ladybird Beetle, 117
Fleas, 108
Flesh Flies, 104
Flies, 92
Flour Beetles, 114, 115
Flower Flies, 98
Forficula auricularia, 27
Fork-tailed Bush Katydid, 31
Formicidae, 127
Foul Water Mosquito, 95
Fragile Looper, 76
Frankliniella occidentalis, 56
Fruit Flies, 105, 106
Fuller's Rose Weevil, 126
Funereal Duskywing, 92
Furniture Beetles, 123
Gall Wasps, 136
Galleria mellonella, 77
Gammarotettix genitalis, 33
Garden Pests, 163
Gelastocoridae, 50
Gelastocoris oculatus, 50
Geometridae, 74
German Cockroach, 33, 34
Gerridae, 50
Gerris remigis, 50
Giant Crane Fly, 93
Giant Silk Moths, 60
Giant Water Bug, 49
Giant Water Scavenger, 112
Golden Eyes, 57
Golden Polistes, 131, 132
Grain Weevils, 114, 115
Granulate Cutworm, 67, 68
Grasshoppers, 27
Gray Bird Grasshopper, 28
Gray Walkingstick, 38
Greater Wax Moth, 77
Green Bottle Fly, 104
Greenhouse Thrips, 56
Ground Beetles, 109
Ground Cricket, 32
Ground Squirrel Flea, 109
Gryllacrididae, 32
Gryllidae, 29
Gryllus sp., 30
Gulf Fritillary, 82
Gyrinidae, 113
Gyrinus, 113
Halictid Bees, 138
Halictidae, 138
Halisidota maculata, 72
Harlequin Bug, 45
Helicoverpa zea, 65
Heliothrips haemorrhoidalis, 56
Hemerobiidae, 57
Hemerocampa vetusta, 65
Hemihyalea edwardsi, 72
Hemiptera, 44
Hermetia illucens, 100
Hesperiidae, 91
Hesperophylax, 58
Hetaerina americana, 26
Hippoboscidae, 107
Hippodamia convergens, 117
Hippodamia quinquesignata, 117
Holorusia grandis, 93
Honey Bee, 98, 100, 131, 140, 141
Honeydew, 53
Hoplosphyrum boreale, 30
Hornet Moth, 79
Horntails, 137
Horse Flies, 98
horse stingers, 24
House Cricket, 29
House Fly, 102, 103, 104
Human Flea, 109
Human Louse, 42
Hyalophora euryalus, 60
Hydrophilidae, 112
Hydrophilus triangularis, 112
Hylephila phylaeus, 91
Hyles lineata, 63
Hymenoptera, 126
Icerya purchasi, 54
Ichneumonidae, 137

Ichneumons, 137
Incisitermes minor, 41
Incurvariid Moths, 78
Incurvariidae, 78
Indian Meal Moth, 78
Irene Underwing, 70
Iridomyrmex humilis, 129
Iris oratoria, 37
Ironclad Beetle, 118
Ischnura, 26
Isoptera, 39
Jerusalem Cricket, 32, 143
Katydids, 31
Khapra Beetle, 122
Kissing Bug, 47
lacewings, 53
ladybird beetles, 53, 115, 116
Laphygma exigua, 67, 68
Large Bee Fly, 101
Largid Bugs, 47
Largidae, 47
Largus cinctus californicus, 47
Lasioderma serricorne, 114
Laspeyresia pomonella, 77
Laspeyresia saltitans, 76
Leaf Cutter Bees, 137, 138
Leaf Hoppers, 51
Lepidoptera, 58
Lepisma saccharina, 22
Leptinotarsa decimlineata, 32
Leptoconops, 96
Leptoconops kerteszi, 96
Leptoconops torrens, 96
Leptocoris rubrolineatus, 46
Leptoglossus clypeatus, 46
Leptopsylla segnis, 108
Leptotes marina, 90
Libellula saturata, 25
Limenitis archippus, 82
Limenitis lorquini, 86
Liometopum occidentale, 130
Lipoptena depressa, 107
Liposcelis divinatorius, 42
Listroderes costirostris obliquus, 126
Litaneutria minor, 37
Litoprosopus coachella, 70
Little House Fly, 103
Live Oak Gallfly, 136
locusts, 51
Long-horned Beetles, 123
Long-horned grasshoppers, 31
Lorquin's Admiral, 86
Louse Flies, 107
Lycaenidae, 90
Lyctus, 122
Lygaeus kalmii, 46
Lymantriidae, 64
Lynchia americana, 107
Lynchia hirsuta, 107
Lyctidae, 122
Machilinus, 23
Maenas vestalis, 71
Malaraeus telchinus, 109
Mallophaga, 42
Mallophora fautrix fautricoides, 100
Manduca sexta, 63
Mantodea, 36
March Flies, 97
Marine Blue, 90
Maritime Earwig, 27
Mayflies, 23
McDunnough's Pero, 75
Meal Moth, 78
Mealworms, 114, 115
Mealybug Destroyer, 117
Mealybugs, 55
Measuring Worms, 74
Mediterranean Flour Moth, 78
Mediterranean Fruit Fly, 106
Mediterranean Mantid, 37
Megachilidae, 137
Membracidae, 52
Menacanthus stramineus, 44
Mesentotoma laguna, 22
Metallic Sweat Bees, 138
Metasyrphus, 98
Mexican Jumping Bean Moth, 76
Mexican Tiger Moth, 73
Microcentrum rhombifolium, 31
Microphotus angustus, 111
Microsiphum rosae, 53
Milkweed Borer, 124
Minor Ground Mantid, 37
Monarch, 82
Moon Umber, 70
Morse's Carinated Shield-back Katydid, 32
Mosquitoes, 94
Moths, 59, 60
Mountain Carpenter Bee, 138
Mourning Cloak, 84
Mouse flea, 108
Mud Dauber, 131, 132, 133
Multicolored Darner, 26
Murgantia histrionica, 45
Musca domestica, 102
Muscid Flies, 102
Muscina stabulans, 103
Muscidae, 102
Mutillidae, 135
Myrmeleon, 58
Myrmeleontidae, 57
Neduba morsei, 32
Neohermes californicus, 56
Neolipoptena ferrisi, 107
Neomachilis, 23
Nerve-winged Insects, 56
Neuroptera, 56
Nicippe Yellow, 88
Noctuidae, 65
Northern Rat Flea, 109
Nosopsyllus fasciatus, 109
Notonecta hoffmanni, 50
Notonecta kirbyi, 50
Notonecta unifasciata, 50
Notonectidae, 49
Nymphalis antiopa, 84
Ocypus olens, 113
Odonata, 24
Oecanthus species, 29
Old World Migratory Locust, 29
Olethreutid Moths, 76
Olethreutidae, 76
Olla abdominalis, 117
Omnivorous Looper, 75
Ophion, 137
Oregon Tiger Beetle, 109
Orgyia cana, 64
Oriental Cockroach, 33, 34
Oriental Rat Flea, 109
Ornate Tiger Moth, 73
Orthoptera, 27
Oryzaephilus surinamensis, 114
Otosema odora, 69
Owlet moths, 65
Pacific Dampwood Termite, 41
Painted Arachnis, 71
Painted Lady, 83
Pale Swallowtail, 80
Palm Moth, 70
Panchlora nivea, 35
Pantomorus godmani, 126
Pantry Beetles, 114, 115
Pantry Moths, 78
Papilo eurymedon, 80
Papilio rutulus, 80
Papilio zelicaon, 81
Papilionidae, 80
Parabacillus hesperus, 39
Paracotalpa, 120
Paralucilia wheeleri, 104
Paranthrene robiniae, 79
Parcoblatta americana, 36
Pastel Skimmer, 25
Pediculus humanus, 42
Pentatomidae, 44
Pepsis, 134, 148
Peridroma saucia, 66, 68
Periodical Cicada, 51
Periplaneta americana, 34
Pero macdunnoughi, 75
Petidia sayi, 44
Petidia uhleri, 44
Petroleum Fly, 106
Phaneropterinae, 31
Phaenicia cuprina, 104
Phaenicia sericata, 104
Phasmida, 38
Philia orbata, 97
Phloedes pustulosus, 118
Phobetus, 120
Phoebis sennae, 90
Phormia regina, 104
Phryganidia californica, 73
Phthirus pubis, 43
Pieridae, 87
Pieris protodice, 88
Pieris rapae, 87
Pine Sawyer, 123
Pink Glowworm, 111, 112
Pleocoma, 119
Pleocoma australis, 120
Pleocoma badia, 120
Pleocoma hirsuta, 120
Pleocoma puncticollis, 120
Plodia interpunctella, 78
Plume Moths, 79
Pogonomyrmex californicus, 129
Polistes fuscatus aurifer, 132

Pollenia rudis, 104
Polycaon stouti, 122
Polyphaga, 120
Polyphemus Moth, 61
Polyphylla, 120
Pomace Flies, 105
Pompilidae, 134
Potato Bug, 32
Powder-Post Beetles, 122
Precis coenia, 85
Prehistoric Insects, 162
Preying Mantis, 36
Prionus californicus, 123
Pristoceuthophilus marmoratus, 33
Prodoxus species, 79
Pseudaletia unipuncta, 67, 68
Pseudococcidae, 55
Pseudolynchia canariensis, 107
Pseudosermyle straminea, 38
Psilopa petrolei, 106
Psocids, 42
Pterophoridae, 79
Pterophylla camellifolia, 31
Pulex irritans, 109
Punkies, 96
Pygmy Blue, 90
Pyralid Moths, 77
Pyralidae, 77
Pyralis farinalis, 78
Quail Louse Flies, 107
Rabbit Flea, 109
Rain Beetles, 119
Rasahus thoracicus, 48
Red Admiral, 84
Red-tinged Skimmer, 25
Reduviidae, 47
Reticulitermes hesperus, 40
Rhagoletis completa, 106
Rickettsia prowazeki, 43
Ring-legged Earwig, 27
Robber Flies, 100
Robust Bot Flies, 104
Rodolia cardinalis, 54, 117
Root Gnats, 97
Rove Beetles, 113
Ruby spot, 26
Sabulodes caberata, 75
Saltatoria, 27
Sand Cricket, 32
Sand Roach, 33, 35
Sand Wasps, 132
Saturniidae, 60
Saw-toothed Grain Beetle, 114, 115
Say's Stink Bug, 44
Scaeva, 98
Scale insects, 53
Scaphinotus, 110
Scarab Beetles, 119
Scarabaeidae, 119
Sceliphron cementarium, 132
Schistocerca vaga, 28
Sciaridae, 97
Scudderia furcata, 31
Scyphophorus yuccae, 125
Senna Sulfur, 90
Serica, 120
Seventeen Year Cicada, 51
Shistocerca, 29
Shistocerca americana, 29
Shistocerca gregaria, 29
Shore Flies, 106
Silk moths, 62
Silverfish, 22
Simulidae, 96
Siphonaptera, 108
Siricidae, 137
Sitophilus, 114
Skippers, 91
Slender Pigeon Louse, 43
Snail Eaters, 110
Snake doctors, 24
Snakeflies, 56
Snowy Tree Cricket, 29
Soldier Beetles, 118
Soldier Flies, 100
Solenopsis molesta, 130
Solenopsis xyloni, 130
Sonoran Bumble Bee, 140
Sour Flies, 105
Southern California Chaparral Camel Cricket, 33
Southern California Mushroom Camel Cricket, 33
Southern Fire Ant, 130
Southern House Mosquito, 95
Sphecid Wasps, 132
Sphecidae, 132
Sphingidae, 63
Sphinx Moths, 63
Spider Wasps, 134
Spittle Bugs, 52
Spodoptera ornithogalli, 67, 68
Spotted Halisidota, 72
Springtails, 22
Squash Bugs, 45
Stable Fly, 102
Stagmomantis californica, 37
Staphylinidae, 113
Stegobium panaceum, 114
Stenopelmatus fuscus, 32
Stick-tight Flea, 109
Stilbometopa impressa, 107
Stink Beetle, 118
Stink Bugs, 44
Stomoxys calcitrans, 102
Stout's Hardwood Borer, 122
Stratiomyiidae, 100
Strawberry Root Weevil, 126
Striped Morning Sphinx, 63
Strymon melinus, 91
Supella supellectilium, 35
Swallowtail Butterflies, 80
Sylvanidae, 114
Syrphidae, 98
Syrphus, 98
Tabanidae, 98
Tabanus punctifer, 98
Tachinid Flies, 101
Tachinidae, 101
Tarantula Hawk, 134, 135
Tarnetrum corruptum, 25
Tarnetrum illotum, 25
Tegeticula maculata, 78
Tenebrio obscurus, 114
Tenebrionidae, 114
Ten-lined June Beetle, 120
Termites, 39
Tetraopes basalis, 124
Tettigoniidae,31
Thermobia domestica, 22
Thief Ant, 130
Thrips, 55
Thyce, 120
Thysanoptera, 55
Thysanura, 22
Tibicinoides cupreosparsus, 51
Tiger Beetles, 109
Tiger Moth, 70
Timema spp., 39
Timemas, 39
Tineid Moths, 76
Tineidae, 76
Tineola bisselliella, 76
Tipula planicornis, 93
Tipulidae, 93
Tomato Sphinx, 63
Tomato worms, 63
Tree cricket, 29
Tree Hoppers, 52
Triatoma protracta, 47
Tribolium, 114
Trichoplusia ni, 68
Trichoptera, 58
Trogoderma granarium, 122
Tropisternus, 112
True Bees, 139
True Bugs, 44
True Fruit Flies, 105, 106
True Lice, 42
Trypetidae, 105, 106
Tule Mosquito, 95
Tussock Moths, 64
Two-spotted Lady Beetle, 116, 117
Two-stabbed Ladybird, 116, 117
Uhler's Stink Bug, 44
Urban Silverfish, 22
Valley Black Gnat, 96
Valley Carpenter Bee, 138, 139
Vanessa atalanta, 84
Variegated Cutworm, 66, 68
Vedalia, 116, 117
Vedalia Beetle, 54
Vegetable Weevil, 126
Velvet-ants, 135
Velvety Tree Ant, 130
Vespid Wasps, 131
Vespidae, 131
Vespula pensylvanica, 131
Vestal Tiger Moth, 71
Veterinary Pests, 163, 164
Viceroy Butterfly, 82
Vinegar Flies, 105
Virginia Lady, 84
Volucella mexicana, 99
Vosnesenski's Bumble Bee, 140
Walkingsticks, 38
Walnut Husk Fly, 106
Wasps, 131
Water Boatmen, 50
Water Midges, 97
Water Scavenger Beetles, 112

Webbing Clothes Moth, 76
Weevils, 109, 114, 125
Western Box-elder Bug, 46
Western Bush Cricket, 30
Western Cone-nose Bug, 47
Western Corsair, 48
Western Drywood Termite, 41
Western Encephalitis Mosquito, 94, 95
Western Flower Thrips, 56
Western Leaf-footed Plant Bug, 46
Western Malaria Mosquito, 96
Western Sand Wasp, 134
Western Short-horned Walkingstick, 39
Western Spotted Cucumber Beetle, 125
Western Subterranean Termite, 40
Western Tiger Swallowtail, 80
Western Tree Hole Mosquito, 95
Western Tussock Moth, 64
Western Wood Roach, 33, 36
West Coast Lady, 84
Wheeler's Blue Bottle, 104
Whirligig Beetles, 113
Whiteflies, 55
Whitelined Sphinx, 63
Whites and Sulfurs, 87
Wild Mouse Flea, 109
Window Fly, 100
Winter Mosquito, 95
Wood Rat Bot Fly, 104
Woodwasps, 137
Xenopsylla cheopis, 109
Xylocopa, 138
Xylocopa brasilianorum varipuncta, 138
Xylocopa californica diamesa, 138
Xylocopa tabaniformis orpifex, 138
Yellow Jacket, 131, 132
Yellow-striped Armyworm, 67, 68
Yucca Moth, 78
Yucca Weevil, 125
Zale lunata, 70
Zootermopsis angusticollis, 41
Zygoptera, 26

PART II. INDEX TO ARTHROPOD SPECIES

Acaridae, 152
Acarid Mites, 152
Acarina, 151, 156
Acarus, 151, 152
Allodermanyssus sanguineus, 153
American Dog Tick, 157
Amphipoda, 160
Anuroctonus phaeodactylus, 142
Aphonopelma reversum, 145
Argas persicus, 158
Argiope aurantia, 149
Armadillidium vulgare, 160
Atopetholus angelus, 160
Arachnida, 142
Arachnids, 142
Araneida, 145
Araneidae, 149
Belkin's Chigger, 154
Bothriocyrtum californicum, 147
Brown Dog Tick, 157
Brown Spiders, 148
Bryobia praetiosa, 152
California Tarantula, 145, 146
Centipedes, 158
Chiggers, 151, 153, 154
Chilopoda, 158
Citrus Red Mite, 152
Clover Mite, 151, 152
Combfooted Spiders, 148
Common Chigger, 154
Common Garden Spider, 149, 150
Common Pillbug, 160
Confusing Scorpion, 142
Crab Spiders, 151
Crustacea, 160
Ctenizidae, 147
Daddy Long-legs, 144
Demodex follicularum, 154
Demodicidae, 154
Dermacentor occidentalis, 157
Dermacentor variabilis, 157
Dermanyssidae, 153
Dermatophagoides, 154, 155
Diplopoda, 160
Dooryard Sowbug, 160
Eotetranychus sexmaculatus, 152
Eremobates gracilidens, 144
Eremobates mormonus, 144
Eremobates purpusi, 144
Eremobates scopulatus, 144
Eremobates zinni, 144
Euschoengastia, 154
Eutrombicula batatas, 154
Eutrombicula belkini, 153, 154
False Spiders, 143
Follicle Mites, 154
Food-infesting Mites, 152
Fowl Tick, 158
Green Lynx Spider, 150
Haemaphysalis leporispalustris, 157
Hair Follicle Mite, 151, 154
Hemerotrecha marginata, 144
Hiltonius pulchrus, 160
House Centipede, 158
House Hopper, 160, 161
House dust mites, 154, 155
Hunting Spiders, 143
Isopoda, 160
Ixodes pacificus, 157
Ixodides, 156
Jumping Spiders, 150
Latrodectus hesperus, 148
Leuronychus pacificus, 145
Litistriatus hesperus, 160
Loxosceles laeta, 148
Loxosceles reclusa, 148
Loxosceles unicolor, 148
Loxoscelidae, 148
Lycosa tarantula, 146
Lynx spiders, 150
Millipedes, 160
Misumenops californicus, 151
Mites, 151
Mouse Mite, 151, 153
Multicolored Centipede, 159
Neotrombicula, 154
Odontacarus, 154
Orb-weavers, 149
Oribatei, 156
Ornithodorus coriaceus, 157
Ornithonyssus bacoti, 153
Oxyopidae, 150
Pacific Coast Tick, 157
Pajaroello, 157, 158
Panonychus citri, 152
Parasitic Mites, 153
Paruroctonus silvestrii, 143
Peucetia viridens, 150
Phalangida, 144
Phidippus formosus, 150
Porcellio laevis, 160
Protolophus singularis, 144, 145
Pyroglyphidae, 154
Pyroglyphid mites, 154
Rabbit Tick, 157
"Red Bugs", 154
Red Jumping Spider, 150
"Red Spider", 152
Rhipicephalus sanguineus, 157
Salticidae, 150
Sarcoptes scabiei, 155
Sarcoptidae, 155
Scabies Mite, 151, 155
Scolopendra polymorpha, 159
Scorpionida, 142
Scorpion Spiders, 143
Scorpions, 142
Scutigera cleopatrata, 158
Shiny-stinged Scorpion, 142, 143
Silvestri's Scorpion, 143
Six-spotted Mite, 152
Skin Mites, 155
Soil Mites, 156
Solpugida, 143
Sowbugs and Pillbugs, 160
Spider mites, 151
Spiders, 145
Sun Spiders, 143, 144
Talitrus sylvaticus, 160
Tarantulas, 135, 145, 146
Tetranychidae, 151
Tetranychus telarius, 152
Theraphosidae, 145, 147
Theridiidae, 148
Therobates morrisi, 144
Thomisidae, 151
Ticks, 156
Trapdoor Spiders, 147
Trombiculidae, 153
Tropical Rat Mite, 151, 153
Two-spotted Mite, 152
Tylobolus claremontus, 160
Tyrophagus, 151, 152
Vejovis confusus, 142
Violin Spiders, 148
Western Black Widow, 148
Western Wood Tick, 157
Wind Scorpions, 143
Wolf Spider, 146

PART III. INDEX TO PLANT HOST SPECIES

Amorpha californica, 89
Arrowplant, 76
Artemesia californica, 75
Asclepias, 82
Atriplex, 90
Brassica campestris, 88
California Sage, 75
California Sister, 86
Canyon Oak, 86
Ceanothus, 76
Cheeseweed, 83
Chenopodium, 90
Coast Live Oak, 72, 73, 136
Common Yucca, 79, 138
Deer-weed, 92
Diplacus longiflorus, 86
English ivy, 75
Eriogonum fasciculatum, 75
False Indigo Plant, 89
Fan Palms, 70
Flat top, 75
Foeniculum vulgare, 81
Indian Tobacco, 76
Limenitus bredowii, 86
Lotus scoparius, 92
Malva parviflora, 83
Milkweed, 82
Nasturtiums, 88
Nettle, 84
Nicotiana glauca, 76
"Oak apples", 136
Parietaria, 84
Passiflora, 83
Passion Flower Vine, 83
Pellitory, 84
Pigweed, 90
Raphanus sativus, 88
Red Berry Buckthorn, 75
Rhamnus crocea, 75
Quercus agrifolia, 72, 136
Quercus chrysolepis, 86
Quercus dumosa, 136
Quercus lobata, 136
Quixote Plant, 79
Sabestiana pringlei, 76
Salt Bush, 90
Sticky Monkey Flower, 86
Sweet Fennel, 81
Urtica, 84
Washingtonia filifera, 70
Washingtonia robusta, 70
Wild Lilac, 76
Wild Mustard, 88
White Oak, 136
Wild Radish, 88
Yucca whipplei, 79, 138